RMRS Rocky Mountain Remediation Services, L.L.C.
. . . protecting the environment

Rocky Flats Environmental Technology Site
P.O. Box 464
Golden, Colorado 80402-0464
Phone:(303) 966-2677
Fax: (303) 966-8244

1F100

000059103

October 16, 1995

95-RF-08038
95-RF-ER-RM-0148-KH

Russell H. Boyd
Kaiser-Hill Company
Rocky Flats Environmental Technology Site
P.O. Box Box 464
Golden, Colorado 80402

TRANSMITTAL OF DRAFT EVALUATION OF ONSITE VERSUS OFFSITE REMEDIATION WASTE MANAGEMENT OPTIONS FOR ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE - AMP-135-95

Action: Please review and return any comments, as soon as possible

The Draft Evaluation of onsite versus Offsite Remediation Waste Management Options for Rocky Flats Environmental Technology Site is attached.

Please review and return any comments, as soon as possible, to Doug Steffen, of my staff. Please contact Doug Steffen at extension 8655 with any questions or comments you may have.

Alan M Parker

Alan M. Parker
Vice President
Environmental Projects Group

CDC:cb

Attachment:
As Stated

cc:
F. W. Chromec
C. D. Cowdery
C. S. Dayton - K-H
D. R. Ericson
O. Erlich
C. S. Evans
J. K. Hopkins
T. M. Lindsay
E. C. Mast
T. P. O'Rourke
Projects File
22.053





ADMIN RECORD

SW-A-004179

# Draft Evaluation of On-Site Versus Off-Site Remediation Waste Management Options For Rocky Flats Environmental Technology Site



Prepared by Rocky Mountain Remediation Services for Kaiser-Hill

**Revision 2**

**October 12, 1995**

2

# Table of Contents



DRAFT



3

## Executive Summary

The purpose of this evaluation is to select the best disposal option for environmental remediation waste at the Rocky Flats Environmental Technology Site (RFETS). On-site disposal was selected as the best of three options: on-site disposal, off-site disposal, and no-action. The selection of on-site disposal was based on the following:

- Projected costs for on-site disposal were almost an order of magnitude lower than for off-site disposal.
- More risk reduction activities could be accomplished in support of the Accelerated Site Action Project (ASAP). These activities could be accomplished sooner, in less time, and at a significantly lower cost.
- There would be is less public exposure during transportation. Also, there would be less involuntary risk.
- There would be less risk of spills in handling and transportation.
- There would be greater capacity for on-site disposal compared to off-site disposal. An on-site facility would be more accessible and available more often when needed.
- There are fewer schedule restrictions for an on-site facility.
- There are fewer analytical requirements for an on-site facility because there is less redundancy is sampling requirements.



The most important difference between the on-site and off-site options is total cost and the effect of cost on the ability to reduce risk at the RFETS. In essence, the more it costs to dispose of a cubic yard (cy) of contaminated material, the fewer cubic yards of material the Environmental Restoration (ER) program will be able to clean up in a given time frame. This effectively prolongs the cleanup efforts at RFETS and allows contaminated materials to remain uncontrolled in the environment for much longer periods of time. In turn, this increases the overall risk at RFETS to human health including both the off-site population and on-site workers, and the environment.

In the past, environmental restoration activities at government facilities have been regarded as having unlimited budgets. Funding was expected to increase with each fiscal year and all restorations were expected to be funded eventually. Hard choices are now necessary as the realities of federal spending reform have imposed limits on funding for environmental restoration. As part of this evaluation, it was necessary to select the waste management option that could best reduce the overall risk to human health and the environment while remaining fiscally responsible. Budget restraints now directly affect the degree of risk reduction. Based on cost effectiveness, the on-site option clearly is the best selection for reducing the overall risk to both the public and environment. With a given budget, more cleanup actions can be performed more effectively, and therefore, the site can be made safer with on-site disposal.

## List of Acronyms

| | |
|---|---|
| ARAR | Applicable or Relevant and Appropriate Requirements |
| ASAP | Accelerated Site Action Project |
| CAMU | Corrective Action Management Unit |
| CCR | Colorado Code of Regulations |
| CDPHE | Colorado Department of Public Health and the Environment |
| cy | cubic yard |
| D4 | Deactivation, Decontamination, Decommissioning, and Demolition |
| DOE | Department of Energy |
| DOT | Department of Transportation |
| EPA | Environmental Protection Agency |
| ER | Environmental Restoration |
| FY | Fiscal Year |
| HW | Hazardous Waste |
| IDM | Investigation-Derived Material |
| IHSS | Individual Hazardous Substance Site |
| LDR | Land Disposal Restriction |
| LLMW | Low Level Mixed Waste |
| LLW | Low-Level Waste |
| NTS | Nevada Test Site |
| ORNL | Oak Ridge National Laboratory |
| OU | Operable Unit |
| PCB | Polychlorinated Biphenyls |
| PPRG | Programmatic Preliminary Remediation Goal |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| RSR | Radioactive Waste Shipment and Disposal Record |
| TSCA | Toxic Substance Control Act |
| TSD | Treatment Storage Disposal |
| VOC | Volatile Organic Compounds |
| WMF | Waste Management Facility |

# 1.0 Introduction

As part of risk reduction at the RFETS, a projected 100,000 cubic yards of environmental remediation waste must be excavated and appropriately managed over the next two fiscal years. This remediation waste from high risk Individual Hazardous Substance Sites (IHSSs), hot spots, and the Solar Evaporation Ponds primarily consists of excavated media with hazardous constituents or with mixed hazardous/low-level radioactive constituents. The reduction of environmental risk is directly dependent on the ability to disposition remediation waste. This document addresses the overall approach to remediation waste; Should remediation waste be managed on-site or off-site?

The following objectives were developed to reflect risk reduction goals as well as safety:

1) Ensure the safety of the public, RFETS workers, and the environment through safe management of environmental remediation waste in a timely manner.

2) Develop a viable means of consolidating and disposing of remediation waste by FY 1997 to support the ASAP and near-term risk reduction goals while addressing long-term liability and safety issues.

3) Provide a cost effective solution that can support aggressive environmental remediation and be implemented under existing budgetary constraints.

The general approach of this evaluation was as follows:

- First, the objectives needed to support RFETS risk reduction were defined.

- Second, three options were developed: no-action, on-site disposal, and off-site disposal. The no-action option was evaluated as an alternative to not implementing or resolving the other two options.

- Third, the options were evaluated in terms of cost, schedule, risks, capacity, and availability. Emphasis was placed on the ability of each option to support overall risk reduction and the ASAP.

- Fourth, the recommended option was selected based on the above criteria.

This document is organized as follows:

**Section 2 -** **Strategic Ties to the Accelerated Site Action Project** describes the importance of resolving remediation waste disposal to achieving the goals of the ASAP

**Section 3 -** **Planned Remedial Activities** summarizes the remediation activities scheduled for FY 96-98 that will require disposal of remediation waste.

**Section 4 -** **Description of Options** describes the options evaluated for remediation waste disposal

**Section 5 -** **Cost Analysis** evaluates each of the options based on estimated cost.

**Section 6 -** **Schedule Analysis** compares the time required for disposal of remediation wastes for each option.

**Section 7 -** **Risk Analysis** evaluates the risks associated with each option.

**Section 8 -** **Capacity and Availability** evaluates each of options storage capacity and ability to accept the remediation waste as generated.

**Section 9 -** **Recommendations** presents the recommended option and supporting rationale.



The evaluation focused on risk reduction activities scheduled for Fiscal Year (FY) 96 through FY98 in the ER budget baseline. These activities target areas with the greatest risk based on currently available data from documented environmental releases. Contamination levels, contaminant- specific risks to human health and the environment, and potential exposure pathways were considered in selecting these areas. The goal is to remediate most of these areas within two fiscal years (i.e. by the end of Fiscal Year FY 97). To achieve this goal, a cost effective waste management facility(ies) must be operable by FY 97. This facility(ies) must demonstrate protectiveness for human health and the environment within a limited budget. In addition, any waste management facility must have the capacity to accept large quantities of remediation waste in a short time frame to support the more streamlined and aggressive cleanup program required for the ASAP.

## 2.0 Strategic Ties to the Accelerated Site Action Project

The ASAP goal is to reach an operational state in which all the RFETS plutonium will be consolidated and most of the risk reduction activities are completed. Under ASAP, "high risk" and "no further action" Individual Hazardous Substance Sites (IHSSs), including all IHSSs and the Operable Unit (OU) 5 and OU 7 landfills outside of the RFETS Industrial Area, will undergo closure. Many of the contaminants are not amenable to treatment and will require excavation and placement in a waste management facility (WMF).

In order to implement ASAP, a decision for an overall approach to remediation waste management is needed. Continued use of temporary storage at the site is not feasible due to the shortage of permitted space and the logistics of storing the large volumes of remediation waste planned for the near future. The sheer volume of remediation waste and the logistics of handling it, require that a waste management facility be available to accept the remediation waste as it is excavated. The approach to remediation waste management has to be determined in this evaluation and implemented prior to excavation in order to support environmental risk reduction and the ASAP. Without a waste management pathway, not only will specific near-term risk reduction actions not be possible, but long-term activities will also be impacted.

## 3.0 Planned Remedial Activities

A remediation waste management strategy must be made effective by FY 97 to support planned activities on high risk areas in FY 96 and FY 97. These activities include:

- The OU 4 Solar Evaporation Ponds remediation which will include materials from the solar pond liners, basecourse, treated sludge, miscellaneous debris, and some vadose zone soils by FY 97.

- Restoration of OU 2 trenches (e.g., trenches T-1 through T-4), 903 Pad area, and the Mound area. The typical excavated media from OU 2 locations will be soils, sanitary sludges, and decomposed drums.

- Excavation of soil and debris from OUs 9 and 10 during the cleanup of tanks T-8, T-9, T-10, T-14, T-16, and T-40 along with IHSS 129.

- The excavation of small volumes of remediation waste from hot spots.

- Dispositioning of Investigation-Derived Materials (IDM) from drilling activities.

- Deactivation, decontamination, decommisioning, and demolition (D4) of RFETS facilities.

Remediation wastes include but are not limited to:

- Contaminated soils and debris collected from accelerated actions and hot spot removal;
- Pond sludge;
- Sediments;
- Toxic Substance Control Act (TSCA) waste, such as asbestos and polychlorinated biphenyls (PCBs);
- Treatment by-products from groundwater, surface water, and/or soil remediation actions;
- IDM from characterization activities, such as wells and borings are also defined as remediation waste; and
- Debris from deactivation and decommisioning activities.



8

Only remediation wastes will be considered in this evaluation; process waste will not be included in the evaluation. For the purposes of this document, OU 4 pondcrete and saltcrete are considered as process waste. The contaminants of concern in these media can be summarized as: radionuclides (e.g., plutonium and americium), heavy metals (such as cadmium and chromium), volatile and semivolatile organic compounds, asbestos, and PCBs.

Waste volume estimates for planned risk reduction activities over the next two years are presented in Table 3-1. These waste volume estimates include only near-term accelerated actions. Additional remediation waste, including remediation waste from D4, could also be disposed of in the two year time frame. A basis of 100,000 cubic yards was used for comparing the options to ensure that planned early actions were covered as well as near-term D4 activities. It is assumed that soils contaminated soils volatile organic compounds (VOC's) would be treated by thermal desorption after which the residuals would be disposed at the original excavation site if they comply with the programmatic preliminary remediation goals (PPRGs). The assumptions for this estimate are presented in Appendix A.

# 4.0 Description of Options

The waste management options were evaluated for all phases of use including transportation to the disposal facility, operations at the facility, and closure. For the on-site management option, consideration was given to design and construction of a new WMF since an on-site facility does not exist that can accept this type or volume of material.

## 4.1 On-Site Management Option

In this option, environmental remediation waste would be disposed of in an on-site WMF designed to handle remediation waste. No specific location was analyzed for this option, although several suitable locations have been identified at RFETS. For this option, it was assumed that the remediation waste would be placed in bulk into a cell; however, the cell would be mapped and gridded to support retrievability. The cell would be designed to meet Resource Conservation and Recovery Act (RCRA) Subtitle C, 6 Colorado Code of Regulations (CCR) 1007-3, and 10-CCR 1007-2, Part 2, Requirements For Siting of Hazardous Waste Disposal Sites. The facility would accept media with low-level radioactive and/or hazardous constituents. This would not preclude the shipment of remediation waste that can be more effectively and economically managed off-site. The facility will be designed and constructed to meet all the applicable federal, state and local regulatory requirements.

## 4.2 Off-Site Management Option

Several off-site locations were considered under this option. Low-level waste (LLW) can be sent to the Nevada Test Site (NTS); however, NTS cannot accept low-level mixed waste (LLMW) under their current waste acceptance criteria. The best facilities for remediation

## Table 3-1
## Waste Identification/Volumes for Waste Management Facility

| Waste Source (OU/IHSS's) | Description of Media | Waste Type | Estimated Total Vol. (cu yds) | Anticipated Volume after Trtmt.(cu yds) | Waste Availability for CAMU Cell |
|---|---|---|---|---|---|
| **OU 4 Solar Ponds** | | | | | |
| Liners | Asphaltic Material | LLMW (rads/metals) | 11800 | 11800 | 3rd Qtr. FY-97 |
| Liners Basecourse | Soils | LLMW (rads/metals) | 11800 | 11800 | 3rd Qtr. FY-97 |
| Sludge | Solidified Sludge | LLMW (rads/metals) | 6000 | 10000 | 1st Qtr. FY-98 |
| Vadose Soil | Soil | LLMW (rads/metals) | 20000 | 20000 | 1st Qtr. FY-98 |
| Debris | Building Materials | LLMW (rads/metals) | 700 | 700 | 1st Qtr. FY-98 |
| Subtotal for OU 4 | | | 50300 | 54300 | |
| **PEAs (Top IHSSs)** | | | | | |
| OU 2 Trench T-1 | Soil, Drums, Pyrophoric U | LLMW (rads/VOC) | 3000 | 1000 | 1st Qtr. FY-98 |
| OU 2 Trench T-2 | Soil | HW (VOC) | 300 | 0 | 4th Qtr. FY-95 |
| OU 2 Trench T-3 | Soil, Drums, San. Sludge | LLMW (rads/VOC) | 2700 | 200 | 3rd Qtr. FY-96 |
| OU 2 Trench T-4 | Soil, Drums, San. Sludge | LLMW (rads/VOC) | 2700 | 200 | 4th Qtr. FY-96 |
| OU 2 Trench T-5 through T-11 | Soil, San. Sludge, Planking | LLMW | 6000 | 1000 | FY-98 |
| OU 2 Mound Area | Soil & Drums | LLMW (rads/VOC) | 5000 | 1500 | 3rd Qtr. FY-97 |
| OU 2 903 Pad & Lip Area | Soil & Asphaltic Mat. | LLMW (rads/VOC) | 10000 | 5000 | 4th Qtr. FY-97 |
| OU 9 Tanks 9 & 10 (includes OU 8 IHSS 118.1) | Soil, tanks, piping | LLMW (rads/VOC) | 2000 | 500 | 2nd Qtr. FY-97 |
| OU 9 Tanks 14 & 16 | Soil, tanks, piping | LLMW | 4450 | 3340 | 4th Qtr. FY-97 |
| OU 9 Tank 8 | Soil, tanks, piping | LLMW | 4500 | 800 | 1st Qtr. FY-98 |
| OU 10 IHSS 129 | Soil | HW (VOC) | 2200 | 0 | 3rd Qtr. FY-96 |
| OU 9 Tank 40 | Soil, tanks, piping | LLMW | 1300 | 130 | FY-97 |
| OU 6 B-1 Dam Hot Spot Removal | Soil | LLW (rads) | 8 | 8 | 1st Qtr. FY-98 |
| Additional Hot Spot Removals | Soil | LLMW | 50 | 50 | 4th Qtr. FY-96 |
| Subtotal for PEAs | | | 44208 | 13728 | |
| **Investigative Derived Material (IDM)** | Drill Cuttings/Soil | LLMW, HW, LLW | 1200 | 180 | FY-97 |
| **Subtotal** | | | 95708 | 68208 | |
| Expansion Factor; 15% | | | 14356 | 10231 | |
| **Grand Total** | | | 110064 | 78439 | |

waste with only hazardous constituents are Subtitle C landfills such as the RCRA landfill in Last Chance, Colorado. At this time, the only facility accepting mixed remediation waste is the Envirocare facility in Utah. For near-term remedial actions, it is anticipated that 95% of the waste will be mixed and would go to the Envirocare facility under this option.

The construction of a new off-site facility was considered; however, it was rejected because it would not meet the schedule requirements for the ASAP. Depending on the location and the operator, many years would be required for a Nuclear Regulatory Commission License, an Environmental Impact Statement, a RCRA permit, land acquisition, and so forth. Only existing facilities that could support the accelerated action schedule were considered.

### 4.3 No-Action Option



This no-action option is an alternative to the development of an ER waste management strategy. It was included to furnish a baseline for RFETS risk reduction that did not include the excavation and removal of ER waste. In this option, all waste materials would be left in place with the exception of those materials that can be treated to remove organic compounds and still meet PPRGs.

## 5.0 Cost Analysis

Based on the waste volume estimates discussed in Section 3.0, Planned Remedial Activities, 100,000 cubic yards was selected as a basis for the cost analysis. Two estimates were developed, one for off-site waste management and one for on-site waste management. No estimate was developed for the "no further action" option which can be assumed to be significantly minor in comparison. The estimates are based on previously incurred costs, professional experience, vendor quotes, conceptual design information, current labor rates, and current adjustment factors.

Currently, the average life-cycle cost for waste disposal off-site can range between $4,000 and $54,000 (cost for OU 1 hot spot removal) per cubic yard (cy). Some of the major factors that affect this range include handling, packaging, transportation, the waste acceptance criteria, amount of waste being shipped at any one time, the time of year during placement, the treatment method used, and the amount of debris in the waste. Where possible, assumptions for off-site disposal were selected so as to lower the cost and improve the feasibility of this option. Based on these assumptions, a life-cycle cost of $4,900 per cy was estimated (see Table 5-1 for the cost summary, see Appendix A for assumptions and Appendix B for the cost basis). This cost includes packaging, handling, treatment, characterization, transportation, and disposal charges. Previously published estimates included only treatment and disposal charges, not the entire life cycle cost. Additionally, this estimate is low due to the assumptions and would likely be much higher if the option were implemented. Based on this rate, RFETS would require approximately $490 million just for disposal in FY 97 through FY 98 in order to meet its near-term risk reduction goals. This estimated cost is more than triple the total projected ER program



11

# TABLE 5-1: ON-SITE VS. OFF-SITE DISPOSAL COSTS



| ACTIVITY | OFF-SITE DISPOSAL TOTAL COST | OFF-SITE DISPOSAL COST/ C.Y. | ON-SITE DISPOSAL | ON-SITE DISPOSAL TOTAL COST | ON-SITE DISPOSAL COST/ C.Y. |
|---|---|---|---|---|---|
| CONTAINERS | $ 1,150,000 | $ 11.50 | | $ 475,500 | $ 4.76 |
| PACKAGING | $ 3,113,800 | $ 31.14 | | $ 3,060,000 | $ 30.60 |
| TREATMENT | $ 150,678,500 | $ 1,506.79 | | $ 57,652,500 | $ 576.53 |
| WASTE CHARACTERIZATION | $ 178,830,000 | $ 1,788.30 | | $ 340,000 | $ 3.40 |
| TRANSPORTATION | $ 19,976,500 | $ 199.77 | | $ 773,500 | $ 7.74 |
| DISPOSAL | $ 140,412,500 | $ 1,404.13 | | $ 44,000,000 | $ 440.00 |
| - DESIGN | | | $ 1,830,000 | | |
| - PERMITTING | | | $ 2,470,000 | | |
| - CELL CONSTRUCTION | | | $ 20,500,000 | | |
| - OPERATIONS | | | $ 7,450,000 | | |
| - CELL CLOSURE | | | $ 13,250,000 | | |
| - POST CLOSURE CARE | | | $ 14,795,000 | | |
| TOTAL COSTS | $ 494,161,300 | $ 4,941.61 | | $ 106,301,500 | $ 1,063.02 |

Note: These costs are based on a waste volume of 100,000 cy.

budget for this period. The budgetary funding levels past FY 96 are not anticipated to change significantly over current levels.

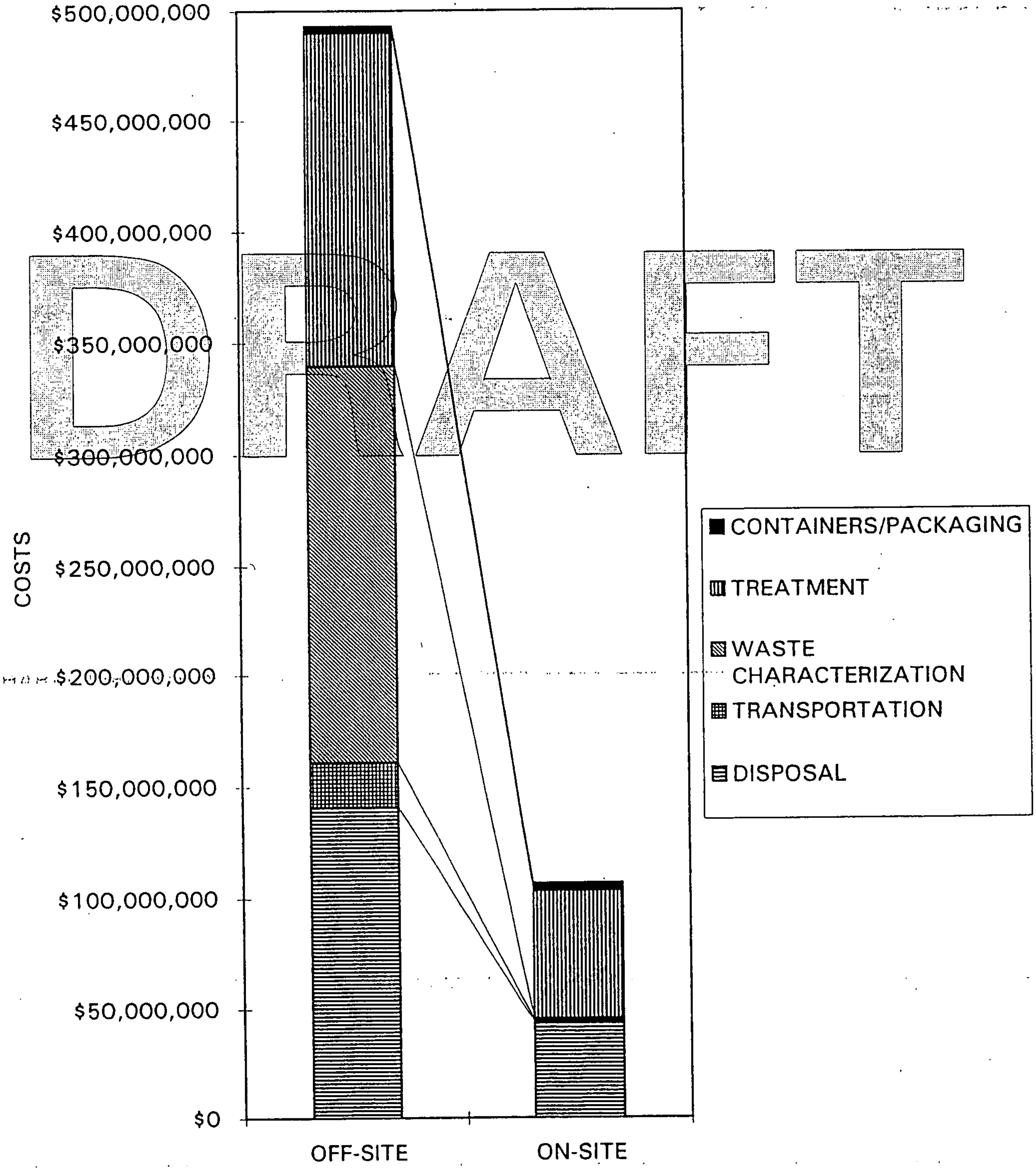
On the other hand, the life-cycle cost to manage wastes on-site will be approximately $1,060 per cubic yard. This estimate includes packaging, handling, transportation, treatment, characterization, cell design and construction, operations, cap design and construction, and post closure care and monitoring. As shown in Table 5-1, RFETS would require approximately $100 million in FY 96 through FY 98 in order to meet the remediation goals (see Appendix A, "Assumptions", and Appendix B, "Basis of Estimates for On-Site and Off-Site Waste Management Cost"). This estimate falls approximately within the projected ER budget and meets most of the risk reduction goals. Figure 5-1 illustrates the magnitude of the cost differences between on-site and off-site disposal.

It is important to note that both of these estimates are conceptual and are subject to variations as more information is obtained. However, because off-site disposal is almost five times more expensive than on-site disposal, it is safe to conclude that the on-site option is the only viable alternative even based on rough order of magnitude estimates.

Table 5-1 shows a big discrepancy in the treatment and characterization costs between the two options. Under Corrective Action Management Unit (CAMU) guidelines the waste does not have to be treated to meet Land Disposal Restrictions (LDRs), however the waste must comply with on-site waste acceptance criteria. The treatment costs for the off-site option were developed from the actual costs and estimated costs for thermal desorption at RFETS. The on-site treatment costs were developed from the OU-4 sludge solidification process and increased to account for any additional miscellaneous treatment that may be required in order to meet the on-site waste acceptance criteria. Appendix B explains how the characterization costs were developed for the two options.

Table 5-2 shows a comparison of costs for on-site versus off-site management of high priority IHSS wastes planned for cleanup by the end of FY 97. Costs for OU 4 pondcrete and saltcrete are not included since these materials were considered process wastes and were not included in the waste volume estimate. The costs for off-site disposal are several times greater than those for management on-site. By managing the waste on-site, the ER program can save at least $340 million dollars in remediating OU 4 and these high risk IHSSs alone.

FIGURE 5-1: ON-SITE VS. OFF-SITE DISPOSAL COST COMPARISON








14

## Table 5-2 Comparison of Costs for On-Site Versus Off-Site Remediation Waste Management

| Location | On-Site Disposal Costs | Off-Site Disposal Costs |
|---|---|---|
| OU 4 Solar Ponds | $58 Million | $268 Million* |
| Top Risk IHSSs | $48 Million | $226 Million |
| Totals | $106 Million | $494 Million |

* Includes costs for OU 4 closure in place



The total volume of remediation waste was another factor adding to the cost difference between on-site and off-site options. If the total volume of remediation waste were sufficiently small, it would be less expensive to ship waste off-site; however, the projected total waste volume is approximately five times greater than that volume. The calculation below shows that on-site management of waste becomes more cost effective for a volume as low as 5,000 cubic yards.

The fixed costs for a 100,000 cy on-site WMF are:

$ 1,500,000 (Permitting)
$ 3,750,000 (Engineering)
$ 5,100,000 (Construction, i.e., mobilization, utilities, etc.)
$ 2,800,000 (Operations)
$ 1,600,000 (Closure)
+$ 1,030,000 (Post Closure Care and Monitoring)
**$15,780,000 (Total)**

The unit cost to dispose of additional cubic yards is then:

(Total WMF Cost - Fixed Cost)/100,000 cy

($106,301,500 - $15,780,000)/100,000 cy = $905/cy

The cost to dispose of waste off-site is approximately $4,900 per cubic yard.

So the break even point in cubic yards is:

$4,941X = $15,780,000 + $905X
$4,036X = $15,780,000

X = 3,909 cy

That amount would allow the remediation of a majority of the IHSSs more cost effectively on site than off-site.

In addition, RFETS can manage all 100,000 cy of waste in an on-site WMF within the same budget that it would take to dispose of approximately 20,000 cy off-site as is shown in the following calculation:

$$\$4,941X = \$106,301,500$$

$$X = 21,500$$

It can be surmised that approximately 80,000 cy of contaminated material reaches final disposition on-site at no additional cost.



## 6.0 Schedule Analysis

One of the key factors for the comparative analysis of on-site versus off-site waste management is schedule limitations. Cost and schedule are inseparable because one affects the other. Due to budget and schedule constraints, the concept of reducing overall risk to the public and environment in less time, at a lower total cost, is more attractive than an extended waste removal process using off-site disposal. In the future, time will become a significant factor because of the availability of funding from Congress.

The no-action approach will obviously delay cleanup. The risk to the public and the environment will continue and probably will increase because of open pathways for contaminant migration. Schedule delays will not only impact the risk but will increase future costs due to escalation when remedial actions are implemented.

Off-site disposal has tremendous implications from a schedule perspective. The RFETS remediation waste is primarily LLMW so most of the waste will go to the Envirocare facility which currently is the only facility in the nation licensed to receive LLMW. As shown from the process flow diagram (See Figure 6-1), a long, arduous process is required (26 weeks or longer) before waste can be shipped off-site and accepted. Problems with the Envirocare facility that impact the schedule include:

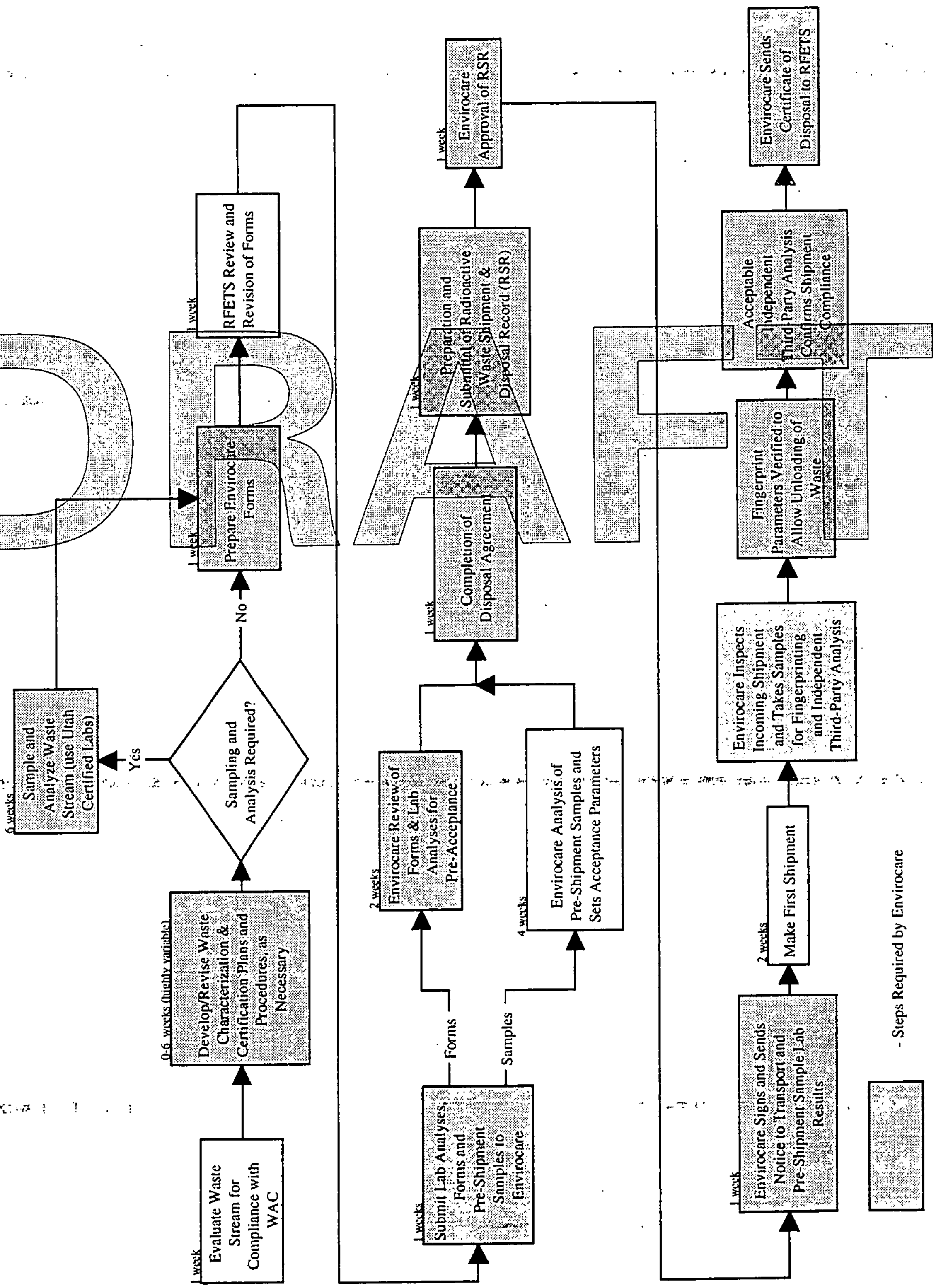
- An estimate of the waste volume must be submitted to Envirocare a full year prior to shipment.

- Waste acceptance is contingent on the submittal of sampling and characterization data. The remediation waste must be sampled and analyzed twice before shipment and again prior to placement in the disposal facility. The initial analysis must be completed before submittal of Envirocare forms.

- Laboratories that characterize the waste must be Utah certified.

- Extensive documentation in addition to waste characterization results is required

## Figure 6-1 Process Flow Sheet For Off-Site Waste-Management Option






17

prior to shipping remediation waste to Envirocare.

- The logistics of handling and shipping the waste are time consuming.
- Additional delays could occur if further treatment is required to meet land disposal restrictions.
- For large bulk media, such as soils, interim staging would be required for storing the waste while awaiting approval for shipment from Envirocare.
- The completion of manifests/travelers and compliance with Department of Transportation (DOT) criteria (which specify weight restrictions and other criteria) create additional delays and costs.



On-site disposal has a more direct schedule. Like Envirocare, the on-site disposal cell would have waste acceptance criteria; however, as seen in Figure 6-2, the path from excavation to final placement would be less intensive and more expeditious. In general only one sampling and analysis event would occur. The logistics of handling and disposal would be more straight forward because of the proximity of the disposal site. Likewise, DOT requirements would not be applicable because no state or interstate highways are traveled and weight restrictions could be modified. A schedule of the on-site and off-site disposal options is shown in Figure 6-3 for comparison.

## 7.0 Risk Analysis

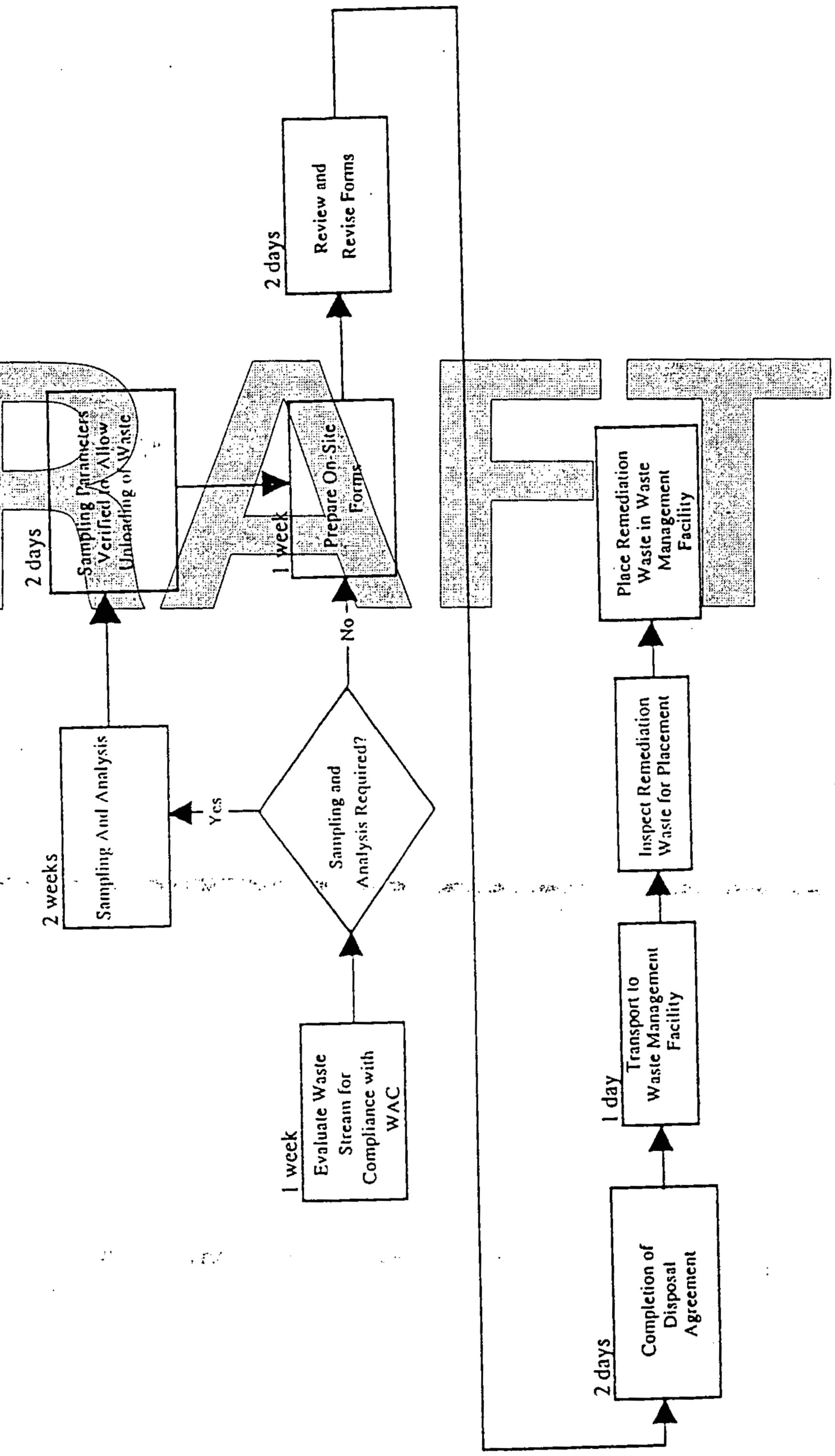
The risk analysis evaluated three types of risks: human health risk, liability risk and risks to the environment.

## 7.1 Human Health Risks to Workers and the Public

For the purposes of this evaluation, human health risk or hazard resulting from exposure to chemicals in the soil or water is defined as the increased chance or probability of developing cancer or other adverse health effect as a result of that exposure. Exposure may occur through ingestion of soils or waters, absorption of chemicals through the skin, and by inhalation of airborne particulates or vapors. The health effects from these exposures could vary from minor skin irritations to cancer, depending on the chemical, the concentration, the exposure pathway, the length of the exposure, and the susceptibility of the receptor.

The nature of the health risks to individuals can be classified as involuntary or voluntary, and as uncontrolled or controlled. Acceptability of a risk depends on its nature. Health risks to hazardous waste/remediation workers at RFETS are both tightly controlled and voluntary. Health risks are controlled through safety and awareness training, protective equipment, and monitoring systems. Efforts are made to minimize risk to the greatest extent possible. The risk is voluntary because the worker has the option of either

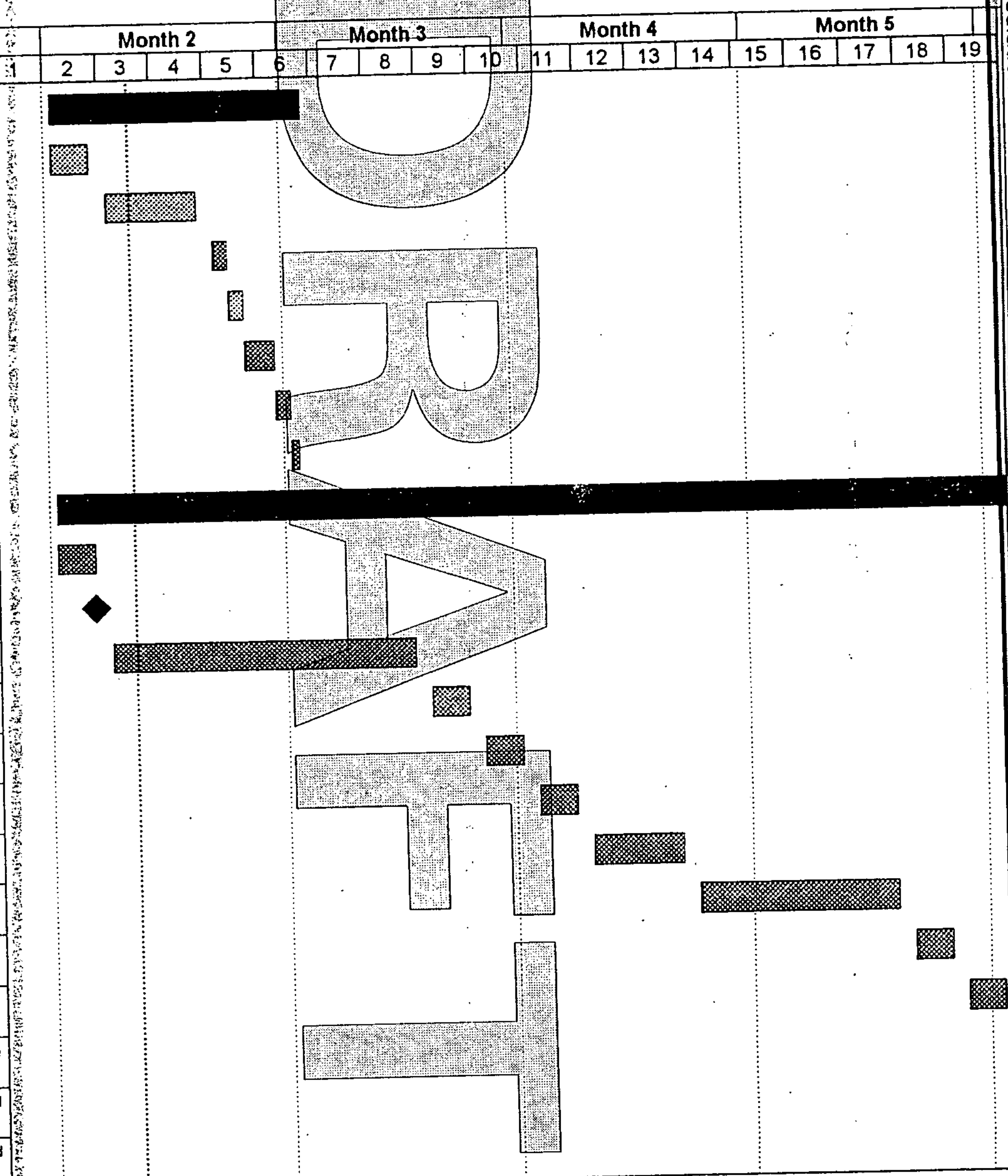
**Figure 6-2 Process Flow Sheet for On-Site Waste Management Option**




19

# Figure 6-3: On-Site and Off-site Approval Schedules

| ID | Task Name | Dur |
|---|---|---|
| 1 | ON-SITE WASTE MANAGMENT FACILITY | 25d |
| 2 | Evaluate Waste Stream for Compliance with WAC | 5d |
| 3 | Sampling and Analysis | 10d |
| 4 | Sampling Parameters Verified to Allow Unloading of Waste | 2d |
| 5 | Prepare On-Site Forms | 2d |
| 6 | Review and Revise Forms | 2d |
| 7 | Completion of Disposal Agreement | 2d |
| 8 | Transport to WMF | 1d |
| 9 | OFF-SITE DISPOSAL | 110d |
| 10 | Evaluate Waste Stream for Compliance with WAC | 5d |
| 11 | Develop Certification Plans and Procedures as Necessary | 0d |
| 12 | Sample and Analyze Waste Stream (use Utah Certified Labs) | 30d |
| 13 | Prepare Envirocare Forms | 5d |
| 14 | RFP Review and Revision of Forms | 5d |
| 15 | Submit Lab Analysis, Forms and Pre-Shipment Samples to Envirocare | 5d |
| 16 | Envirocare Review of Forms & Lab Analysis for Pre-Acceptance | 10d |
| 17 | Analysis of Pre-Shipment Samples & Sets Acceptance Parameters | 20d |
| 18 | Completion of Disposal Agreement | 5d |
| 19 | Prep and Submit Radioactive Waste Shipment & Disposal Record | 5d |
| 20 | Evirocare Approval of RSR | 5d |
| 21 | Envirocare Signs and Sends Notice to Transport | 5d |
| 22 | Make First Shipment | 10d |






20

accepting or declining the task. Furthermore, the risk is clearly communicated, controlled, and accepted by the worker. Risks to the community due to future land uses at the site or from remedial activities are generally not voluntary and can not be controlled to the same extent as risk to a worker. If the decision is made to take no action or to transport wastes off-site, the ability to minimize human health risks to the community is greatly diminished.

For the three options, the human health risk evaluation must consider very different ways in which people could be exposed to radiological or hazardous contaminants (exposure scenarios). Worker safety is a factor for both on-site and off-site disposal of wastes. Risks to public safety due to accidents in transportation and handling of the waste is a factor for the off-site disposal option. This could include injuries and fatalities, in addition to accidental radiological or hazardous releases.



Of the three options, the no-action alternative presents the greatest human health risk to the community in the long term. The magnitude of the risk depends upon the types of exposures to the public, the concentrations and types of chemicals present. This is dependent on the actions taken to prevent off-site migration and on the future land use permitted on what is now the Rocky Flats site.

Risk assessments have been completed on areas in the Buffer Zone that were thought to be contaminated. The human health risks for OUs 1, 2, 5, and 6 have been characterized as part of the RCRA Facility Investigation/Remedial Investigation process. These assessments characterize the human health risks of the no-action option.

Exposures to a potential office worker and to an open-space recreational user present the highest risk estimates. Cancer risks for office workers due to contaminant exposure in buildings projected for the above OUs varied from 2 in 10,000 in OU 1 to 5 in 100,000 in OU 6. This means that if 10,000 office workers worked in the highest risk area for 25 years, not more than two would be expected to develop cancer due to exposure to chemicals or radionuclides. The estimated risks to open space users were even lower, varying from 1 in 100,000 to less than 1 in 1,000,000. This means that for every person who uses the RFETS Buffer Zone for open space recreation for five hours twice a month over a 25 year period only one out of 100,000 people might develop cancer due to contaminant exposure. These risks are very low when compared to the 25 to 30 people out of 100 who develop cancer during their lifetimes due to other causes.

Risks were also calculated for the exposure of off-site residents to contaminants in OU 2. The risk of cancer to a resident living near the site due to off-site migration of OU 2 contaminants is much less than one in a million, varying from 1 in 10,000,000 to 1 in 100,000,000,000. These risks are considered too low to be of consequence. Data from recent accelerated actions indicate that OU 2 contaminant concentrations could be significantly higher than originally estimated and likewise the human health risks to construction workers could be higher if the no-action option were implemented.

Risk assessments for the Industrial Area have not been conducted. It is expected that the human health risks will be higher than the Buffer Zone risks due to the intense industrial activity that has taken place there for the last 50 years. Investigation data suggest that contaminant concentrations are significantly higher than levels in the Buffer zone, and therefore, there are higher risks to workers if no-action were taken. Without source removal, there is also a much higher potential for release to the community during plant shut down operations.

The remaining two options are on-site and off-site disposal of remediation wastes. After the remediation waste has been placed in the disposal cell, the risks associated with these options should not be significantly different between the two options. However, the risks to both workers and the public are expected to vary greatly in the interval between excavation and placement in the waste cell. The differences in risks are due to uncertainties associated with transportation of the wastes.

On-site transportation involves the movement of wastes by truck for a distance of less than 3 miles, through a controlled environment (the plant site). Risks associated with this movement can be tightly controlled, especially with respect to the community and worker exposure. Off-site transportation involves the movement of low-level, mixed, and hazardous wastes for distances of about 700 miles by rail and/or trucking. It is estimated that during the disposal effort over 2.5 million miles would be logged by trucks off-site. For the total waste volume, based on national statistics ("Accident Facts", National Safety Council, 1994), it is expected that 5 accidents would occur during transportation to the off-site repository. These accidents would not necessarily be fatalities but could result in personal injuries and/or property damage and therefore, reflect a potential for accidental spills. As a result of these accidents, communities along the route from RFETS to the disposal cell could be exposed to both chemical and radiological contamination. The magnitude of these risks are difficult to quantify; however, these exposures would be both involuntary and uncontrolled and, as such, may not be acceptable to potentially exposed communities.

Human health risks from on-site construction are dependent on location. The risk to the public will be minimal and worker risk can be tightly controlled. These risks will be minimized through dust suppression, personal protective equipment, training, and other safety measures.

In summation, the on-site waste management is the best option in terms of human health risks for the following reasons:

- The No-Action Option would provide no risk reduction at all.
- Additional handling and transportation to the off-site facility increases the likelihood of an accident resulting in injuries or spills.
- The Off-Site Disposal Option could pose involuntary and uncontrolled risks.
- The On-Site Disposal Option is more amenable to risk management because risks can be controlled. Health risks to workers would be better known and more risks

would be voluntary.

- Finally, fewer overall risk reduction activities (including source removal) would be able to occur when using off-site disposal because less funding would be available.

The On-Site Disposal Option offers the greatest overall risk reduction. Risk management could be conducted in a tightly controlled manner. Remediation waste would not be moved through communities where the public could be involuntarily subjected to accidental spills. Additional risk reduction could occur sooner and at a lower cost reducing exposure pathways through the air, surface waters, and ground water.

## 7.2 Liability Risks

In evaluating liability, both near-term and long-term liability risks were analyzed. Near-term impacts include the liability from spills that could occur in handling and transporting the remediation waste. Long-term liability risks include the ability to manage materials safely over time and long-term fiscal liability. These long-term risks could exist because some contaminants present in the remediation waste are resistant to natural degradation processes.



The liabilities involved with the no-action option present the greatest risk due to the potential that contaminants could migrate as airborne particulates or through surface waters off-site to private and public lands and bodies of water. Potential fiscal liability for cleanup of larger areas of contamination and possible payments for damage to human health and the environment is great. Increased exposure pathways create a greater possibility for contamination of off-site lands, thus creating more liability due to suits for damage of property of stakeholder under §310 of CERCLA than either on-site or off-site management of remediation waste. There is also a potential for public exposure in the future if land uses change. Without some removal of contaminants, the site can not be released for other uses.

The increased liabilities involved with the off-site disposal option are due to spills that could occur during transportation because of the additional mileage to off-site facilities including damage caused by contaminated media being spread on uncontaminated roads and off-site property. Additionally, physical damage could occur to people, vehicles, and property.

Long-term, both on-site and off-site waste management options were deemed to be equally effective in containing contaminants because of similar design and similar regulatory Applicable or Relevant and Appropriate Requirements (ARARs). Both RFETS and NTS are Department of Energy (DOE) facilities. Other facilities are under private ownership. NTS cannot accept RCRA listed waste. This severely limits the volume of RFETS waste that NTS can accept. For the off-site option, most of the remediation waste would have to be managed in facilities that rely on the viability of a private firm to ensure continued operation. For the DOE, this reliance on a private firm is a risk in terms of liability, since there is no guarantee of continued effective operation. There is also no guarantee that the facility will remain effective over the hundreds or even thousands of years that the waste will pose a risk. Under the "cradle to grave" policy of RCRA, waste remains the responsibility of the generator forever. A comparison of Liability Risks is presented in Table 7-1.

## Table 7-1 Comparison of Liability for On-Site Versus Off-Site Waste Management Options

| Liability | No-Action Option | On-Site Management Option | Off-Site Management Option |
|---|---|---|---|
| **Transportation Risks** | Not Applicable | Reduced mileage to WMF would reduce likelihood of a spill. If a spill did occur it would be on DOE property and therefore would not affect private or public property. | Increased liability risk due to additional distance to WMF. Spill or accident could damage public or private property off-site. |
| **Handling Risks** | Not Applicable | Less handling prior to shipment would reduce worker exposure and accidents. | Additional handling prior to shipment could increase liability risk due to worker accidents and exposure. |
| **Long-Term Fiscal Liability** | Liability risk due to potential migration of contaminants via groundwater, surface water, and airborne particulates. | Reduced liability risk-WMF remains on government property. | Possibility that operator might not exist in future. Liability for remediation waste could fall back to DOE based on RCRA cradle to grave. requirement |
| **Long-Term Effectiveness** | Contaminated materials continue to be exposed to environment. Cleanup costs increase due to increase in areas of contamination. | Due to similar siting requirements on-site versus off-site are approximately the same. | Due to similar siting requirements on-site versus off-site are approximately the. same. |

## 7.3 Impact to the Environment

Environmental impacts to air quality, surface water, groundwater, soils, and ecosystems were considered for the three options. Impacts due to construction and/or expansion of off-site facilities were not considered because it was assumed these impacts had already occurred. Environmental impacts from source removal were assumed to be similar between the on-site and off-site options. Dust suppression, erosional control, and other efforts will be used to minimize the impact. Due to regulatory requirements, both on-site and off-site options were assumed to be adequately designed to protect the environment once the remediation waste had been placed in the facility.

### 7.3.1 No-Action Option



The no-action option would have the most detrimental impacts to the environment because the least amount of effort would be put into restricting the migration of contaminants.

<u>Impact to Air Quality</u>
There could be local air quality impacts due to the dispersion of contaminated soils which were not remediated. Emission rates of volatiles in subsurface soils will be dependent upon future activities at the site. Potential exposures or releases could result from future events such as construction or erosion.

<u>Ecological Impact</u>
Impacts to plants and wildlife could continue to slowly increase as contaminants migrate. Contaminants will have the potential to slowly move from sources to groundwater and then from groundwater to surficial waters which in turn increases exposure to surficial ecosystems.

<u>Impact to Soils And Sediments</u>
The volume of contaminated soil will increase slowly as free phase solvents and contaminated groundwater spread out. Sediments could be impacted as airborne contaminants settle in drainages, seeps bring contaminants to the surface, and/or erosion occurs.

<u>Impact to Water Quality</u>
Ground water plumes will continue to spread due to diffusion and advection. Additional contaminants will leach into groundwater and surface waters because the sources of contaminants have not been removed. Exposure to both on-site and off-site receptors is possible.

## 7.3.2 Off-Site Option

**Impact to Air Quality**
Direct environmental impacts include vehicle exhaust during transportation of the excavated materials and particulates from excavation and placement of contaminated media. There is a potential for a spill to occur during handling and transportation, resulting in the dispersion of contaminated dust or vapors. Dust control during the spill cleanup should reduce this impact.

**Ecological Impact**
No direct impact to the ecosystem is anticipated, except if a spill were to occur during handling or transportation. If excavation of a spill were required, plants and/or habitats could be destroyed. Irreversible harm could occur, if after excavation activities, replacement of these plants and/or habitats is not successful.

**Impact to Soils And Sediments**
As with the other environmental impacts, if a spill occurred during handling or transportation, there could be a direct impact to soils. Excavation of the contaminated soil would be required and, based on the characterization of the spill area, a greater volume of contaminated soil could require remediation.

**Impact to Water Quality**
No direct environmental impact is anticipated, except if a spill occurs during handling or transportation. Contamination of the groundwater and/or surface water is possible depending on the location of the spill.

## 7.3.3 On-Site Option

This alternative assumes that the location of a WMF will be at RFETS; however, no specific on-site location was evaluated for a WMF. Environmental impacts are location-specific and this evaluation could change based on the selected location.

**Impact to Air Quality**
Direct environmental impacts include vehicle exhaust during transportation of the excavated materials and particulates from excavation and placement of contaminated media. There is a potential for a spill to occur during handling and transportation, resulting in the dispersion of contaminated dust or vapors. Impacts would be controlled by operational control of particulate and airborne contaminants.

**Ecological Impact**
Ecological impacts would be dependent on where a WMF would be placed on plant site. Impacts to plant communities, wetlands, and other habitats could be minimized if the selected location was previously developed. Likewise, the impact to threatened and endangered species is also expected to be minimal, particularly for locations in or near the industrial area of the site.

### Impact to Soils And Sediments

Minimal damage will occur to the top soil at the selected location for the WMF. A higher erosional impact could also occur particularly if the WMF is situated close to areas with high natural erosion rates such as drainage basins and slopes; however, through siting and erosional controls this effect can be minimized. Spills could also occur that could impacts surficial soils.

### Impact to Water Quality

Based on the siting requirements in 6 CCR 1007-2, the facility will isolate wastes for a thousand years from natural environmental pathways that could expose the public. Therefore, no impact on water quality is anticipated for the on-site option. An on-site WMF would include a groundwater monitoring system for early detection of contaminant migration. There is a possibility of spills during transportation and handling; however, this risk is much less than the off-site option due to the close proximity of the WMF and fewer labor intensive handling requirements prior to placement of the remediation waste.

A summary of potential environmental impacts is given in Table 7-2.



## Table 7-2 Summery of Environmental Impacts

| Option | Air Quality Impact | Ecological Impacts | Soil And Sediment Impacts | Water Quality Impacts |
|---|---|---|---|---|
| **No-Action Option** | Airborne dispersal of contaminants in soils | Damage to local ecology due to unchecked migration of contaminants | Increase in contaminated areas due to unchecked migration of contaminants | Increase in plume size and increased transport of contaminants to surface water |
| **Off-Site Disposal Option** | Possible impact due to spills otherwise minimal | Possible impact due to spills otherwise minimal | Possible impact due to spills otherwise minimal | Possible impact due to spills otherwise minimal |
| **On-Site Disposal Option** | Airborne particulates/ contaminants generated during construction. Possible impact due to spills. | Dependent on location. Impacts to plants, animal habitat, and endangered species can be minimized through location selection process. | Dependent on location. Possible irreversible impact to the topsoil. Erosional impacts are also possible. | Minimal impact |

## 8.0 Capacity and Availability

The capacity and availability for the three different remediation waste management options are significant factors in the decision making process. As a permitted treatment, storage, and disposal (TSD) facility (e.g. existing RCRA Permit #91-09-30-01 for storage), RFETS has temporarily stored waste for short and long term until off-site disposal could occur. The cost impacts have been enormous in providing capital investment for storage facilities, and the required routine maintenance and scheduled walkdowns of waste inventories.

As mentioned previously, the majority of ER remedial waste media is projected to be contaminated soils and designated as LLMW. The most cost effective and efficient manner in handling this waste media is through bulk (e.g., tandem dump trucks or large roll-off containers) versus drums or crates. RFETS has a permitted storage capacity of 23,700 cy for LLMW. An inventory of LLMW as of January 1995 accounts for 19,300 cy, which leaves 4400 cy of usable storage space (Reference Table 8-1, Permitted and Interim Status Storage Units). The permitted capacity of several of the RCRA units is larger than the available physical capacity of the unit. The permitted capacity can never be realized because of the physical limitations of the facility. A majority of the permitted facilities are structured for storage of drums and crates and not the roll-off containers used for bulk material. As was shown in Table 3-1, the ER waste generation rate would surpass the existing available on-site storage space before off-site shipment could occur. Common sense dictates that waste should not be generated unless the material could be immediately disposed of and not be placed into interim storage. The evaluation of each option with regards to capacity and availability will be reviewed.

For the no-action option, there is no driving factor since no removal action will take place. The waste material would remain as is with a high level of risk exposed to the public and the environment. Therefore, capacity and availability have no significant impact.

For the off-site disposal option, capacity and availability are significant factors. Oak Ridge National Laboratory (ORNL) is the DOE facility that has contracted with Envirocare for all DOE facilities. The contractual maximum waste limit which all DOE facilities combined can ship to Envirocare is 350,000 cy over the entire contract life. A further breakdown of this value is 70,000 cy per year by all combined facilities. However, the waste acceptance criteria imposed by Envirocare to waste generators requires a rigorous process of verification and assurance for compliance with Land Disposal Requirements. A process flow chart that outlines the duration of these requirements is shown as Figure 6-1. As shown from this figure, waste generated cannot be shipped offsite until approval is granted from the disposal site (Envirocare); historically this has been a 26-week process. The requirement that all waste characterization be conducted by Utah certified laboratories further restricts the availability of resources. Additionally, DOT requires specific maximum loads for trucking on state and interstate highways. Because of these weight restrictions, each truck must carry smaller volumes of remediation waste for off-site shipment than they could for on-site shipment.

# TABLE 8-1 PERMITTED AND INTERIM STATUS STORAGE UNITS

(Reference: 1995 Comprehensive Waste Management Plan)

| Unit | Unit Name | Waste Type | Permitted/Interim Status Storage Capacity | | Physical Capacity (m3) | | On-Hand Inventory (m3) | | Remaining Capacity (m3) | | | Comment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Liquid | Total | Liquid | Solid | Liquid | Solid | Liquid | Solid | Total | |
| 1 | Main Hazardous Waste Storage Area | LLM | 466.85 | 466.85 | 313.93 | 313.93 | 12.83 | 0.00 | 301.10 | 301.10 | 301.10 | Liquid permitted/interim status capacity equals |
| | | HAZ | 466.85 | 466.85 | 152.92 | 152.92 | 79.19 | 49.23 | 24.50 | 24.50 | 24.50 | total permitted/interim status capacity. |
| | | Total | 466.85 | 466.85 | 466.85 | | 92.20 | 49.23 | 374.65 | 325.60 | 325.60 | Administrative limit of 200 cu yd. for HAZ waste. |
| 6 | Chip Drum Storage Area: Building | LLM | 4.43 | 4.43 | 4.43 | 4.43 | 0.00 | 0.63 | 3.80 | 3.80 | 3.80 | |
| | | Total | 4.43 | 4.43 | 4.43 | | 0.00 | 0.63 | 3.80 | 3.80 | 3.80 | |
| 10 | Drum Storage Area: Building 561 | LLM | 78.74 | 78.74 | 78.74 | 78.78 | 61.92 | 0.00 | 15.43 | 15.43 | 15.43 | Total on-hand inventory includes nonhazardous |
| | | Total | 78.74 | 78.74 | 78.74 | | 63.31 | 0.00 | 15.43 | 15.43 | 15.43 | waste stored in this unit. |
| 11 (Includes Units 61 & 62) | Container Storage Area Building 776, Room 134 | LLM | 0.00 | 255.88 | 4.78 | 14.34 | 0.00 | 39.36 | 4.78 | 20.08 | 24.86 | Total on-hand inventory includes nonhazardous |
| | | TRM | 0.00 | 113.93 | 0.00 | 113.93 | 0.00 | 39.06 | 0.00 | 24.86 | 24.86 | waste stored in this unit. |
| | | Total | 0.00 | 255.88 | 133.05 | | 0.00 | 108.19 | 0.00 | 24.86 | 24.86 | Twenty five percent of LLM physical capacity |
| | | | | | | | | | | | | reserved for repacking |
| 12 | Drum Storage Area: Building 776, Room 237 | LLM | 37.89 | 37.89 | 35.17 | 35.17 | 0.00 | 29.13 | 0.17 | 0.17 | 0.17 | Liquid permitted/interim status capacity equals |
| | | Total | 37.89 | 37.89 | 35.17 | | 0.61 | 34.39 | 0.17 | 0.17 | 0.17 | total permitted/interim status capacity. |
| | | | | | | | | | | | | Total on-hand inventory includes nonhazardous waste stored in this unit. |
| 13 | Mixed Waste Storage: Building 884 | LLM | 139.91 | 209.86 | 194.82 | 194.82 | 0.42 | 168.78 | 20.10 | 20.10 | 20.10 | Total on-hand inventory includes nonhazardous |
| | | Total | 139.91 | 209.86 | 194.82 | | 0.42 | 174.30 | 20.10 | 20.10 | 20.10 | waste stored in this unit. |
| 14 | Centralized Waste Storage Facility: Building 906 | LLM | 0.00 | 3975.92 | 0.00 | 2857.70 | 0.00 | 0.00 | 0.00 | 2857.70 | 2857.70 | Liquid storage not allowed. |
| | | HAZ | 0.00 | 3975.92 | 0.00 | 2857.70 | 0.00 | 0.00 | 0.00 | 2857.70 | 2857.70 | Physical capacity assumes 1:1 ratio of crates to |
| | | Total | 0.00 | 3975.92 | 2857.70 | | 0.00 | 0.00 | 0.00 | 2857.70 | 2857.70 | 55 gallon drums. |
| 15A | 904 Pad and Cargo Containers | LLM | 60.31 | 844.28 | 60.31 | 478.18 | 0.84 | 383.81 | 59.47 | 94.37 | 153.84 | Physical capacity limited due to stacking and |
| | | Total | 60.31 | 844.06 | 538.49 | | 0.84 | 383.81 | 59.47 | 94.37 | 153.84 | large container constraints. |
| 15B | Mixed Waste Storage Area: 904 Pad | LLM | 8181.22 | 8181.22 | 8181.22 | 8181.22 | 0.00 | 5041.73 | 3139.49 | 3139.49 | 3139.49 | Liquid permitted/interim status capacity equals |
| | | HAZ | 8181.22 | 8181.22 | 8181.22 | 8181.22 | 0.00 | 0.00 | 3139.49 | 3139.49 | 3139.49 | total permitted/interim status capacity. |
| | | Total | 8181.22 | 8181.22 | 8181.22 | | 0.00 | 5041.73 | 3139.49 | 3139.49 | 3139.49 | |
| 17 | Mixed Waste Storage: Building 777, Room 423C | LLM | 0.00 | 1.25 | 0.00 | 0.84 | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | Liquid storage not allowed. |
| | | Total | 0.00 | 1.25 | 0.84 | | 0.00 | 0.84 | 0.00 | 0.00 | 0.00 | |
| 18.03 | Environmental Waste Drum Storage, Tent 1 | LLM | 718.74 | 718.74 | 718.74 | 718.74 | 0.00 | 8.40 | 472.34 | 472.34 | 472.34 | Liquid permitted/interim status capacity equals |
| | | HAZ | 718.74 | 718.74 | 718.74 | 718.74 | 0.00 | 238.00 | 472.34 | 472.34 | 472.34 | total permitted/interim status capacity. |
| | | Total | 718.74 | 718.74 | 718.74 | | 0.00 | 8.40 | 710.34 | 710.34 | 710.34 | |
| 18.04 | Environemental Waste Drum Storage Unit | LLM | 416.30 | 416.30 | 416.30 | 416.30 | 0.00 | 76.27 | 340.03 | 340.03 | 340.03 | Liquid permitted/interim status capacity equals |
| | | HAZ | 416.30 | 416.30 | 416.30 | 416.30 | 0.00 | 0.00 | 340.03 | 340.03 | 340.03 | total permitted/interim status capacity. |
| | | Total | 416.30 | 416.30 | 416.30 | | 0.00 | 76.27 | 340.03 | 340.03 | 340.03 | |
| 19 | Mixed Waste Storage Area: Building 374, Room 3813 | LLM | 180.45 | 180.45 | 135.49 | 135.49 | 0.00 | 49.12 | 0.00 | 0.00 | 0.00 | Liquid permitted/interim status capacity equals |
| | | TRM | 105.51 | 105.51 | 105.51 | 105.51 | 0.00 | 45.99 | 0.00 | 0.00 | 0.00 | total permitted/interim status capacity. |
| | | Total | 180.45 | 180.45 | 135.49 | | 0.00 | 135.49 | 0.00 | 0.00 | 0.00 | Total on-hand inventory includes nonhazardous |
| | | | | | | | | | | | | waste stored in this unit. |
| 20 | Shipping Storage Area: Building 664 | LLM | 1911.50 | 1911.50 | 601.74 | 601.74 | 0.00 | 80.36 | 70.83 | 70.83 | 70.83 | Liquid permitted/interim status capacity equals |
| | | HAZ | 1911.50 | 1911.50 | 601.74 | 601.74 | 0.00 | 1.05 | 70.83 | 70.83 | 70.83 | total permitted/interim status capacity. |
| | | TRM | 448.82 | 448.82 | 448.82 | 448.84 | 0.00 | 183.77 | 70.83 | 70.83 | 70.83 | Total on-hand inventory includes nonhazardous |
| | | Total | 1911.50 | 1911.50 | 601.74 | | 0.00 | 530.91 | 70.83 | 70.83 | 70.83 | waste stored in this unit. |
| 24 | Mixed Waste Storage: Building 964 | LLM | 0.00 | 466.36 | 0.00 | 442.93 | 0.00 | 438.69 | 0.00 | 4.24 | 4.24 | |
| | | Total | 0.00 | 466.36 | 442.93 | | 0.00 | 438.69 | 0.00 | 4.24 | 4.24 | |
| 25 | Mixed Waste Storage | LLM | 10704.40 | 10704.40 | 10704.40 | 10704.40 | 0.00 | 5753.80 | 4950.60 | 4950.60 | 4950.60 | Liquid permitted/interim status capacity equals |
| | | HAZ | 10704.40 | 10704.40 | 10704.40 | 10704.40 | 0.00 | 0.00 | 4950.60 | 4950.60 | 4950.60 | total permitted/interim status capacity. |
| | | Total | 10704.40 | 10704.40 | 10704.40 | | 0.00 | 5753.80 | 4950.60 | 4950.60 | 4950.60 | |
| 27 | Mixed Waste Storage: Building 776 | LLM | 10.41 | 10.41 | 10.09 | 10.09 | 7.56 | 0.84 | 0.43 | 0.43 | 0.43 | Liquid permitted/interim status capacity equals |
| | | Total | 10.41 | 10.41 | 10.09 | | 7.56 | 2.10 | 0.43 | 0.43 | 0.43 | total permitted/interim status capacity. |
| | | | | | | | | | | | | Total on-hand inventory includes nonhazardous waste stored in this unit. |



29

Capacity and availability appear more attractive for on-site disposal. The waste disposal cell would be designed and constructed for a net volume of 100,000 cy. No restriction on the annual volume of waste would be imposed on the generator. In fact, the operations on-site could probably accept up to 500 cy per day. It is unlikely that the rate of removal and treatment of remediation waste could exceed the acceptance rate. In other words, removal actions would not be impeded by an on-site waste management facility like they could at an off-site facility. The waste acceptance criteria imposed by the on-site disposal cell would be less complicated than the off-site option and would not become a lengthy process as shown in Figure 6-2. Also, DOT load requirements are not as stringent since no state or interstate highways are used. As a summary of comparisons for the different options, Table 8-2 summarizes the capacity and availability of each option.

**TABLE 8-2: COMPARISON OF CAPACITY AND AVAILABILITY OF WASTE MANAGEMENT OPTIONS**



| Options | Maximum Capacity (Volume) | Availability | Advantages/Restrictions |
|---|---|---|---|
| On-Site Disposal | 100,000 Cubic Yards | Readily available (once constructed) and limited by maximum capacity. | 1.No restrictions on the volume accepted except total capacity;<br>2.Waste Acceptance Criteria not as stringent; and<br>3.DOT requirements are not applicable. |
| Off-Site Disposal | 70,000 Cubic Yards* | Five years*** | 1.Approval granted by Envirocare;<br>2.Waste Characterization done by certified Utah Laboratories; and<br>3.DOT requirements for trucking on highways. |
| No-Action Option | 4,425 Cubic Yards ** | No impact | Capacity is restricted by the current RFETS capability to store waste. |

Notes:

* Maximum waste limit which can be shipped to Envirocare per year for five years from <u>all</u> DOE facilities according to contract with DOE. 350,000 cubic yards is maximum waste capacity for <u>all</u> DOE facilities for Envirocare during the life of the contract.

** Remainder of the space available at RFETS for the storage of LLMW (based on the inventory as of January 1995).

*** Based on the current contract expiration with Envirocare. Conditionally, contract may be approved for extension after five years.

# 9.0 Recommendations

The evaluation indicates that disposal of ER waste on-site is the best option. It is more cost effective, better supports the ASAP, reduces government liability and provides greater support for the reduction of risks to the public and environment.

It is evident that accelerated actions are needed to prevent further contaminant migration. In order to compare the effects of on-site versus off-site disposal, a hypothetical model (see Table 11-1) was developed that tied in costs, waste volumes, and accelerated actions. The accelerated actions and waste volumes in Table 5-1 were evaluated under a fixed budget of $10 million in FY 96 and $25 million in each subsequent year until all of the actions were completed. This budget is based on the current FY 96 budget and will be increased in future years. Waste minimization treatment of ER waste by thermal desorption was incorporated into the model. These soils were assumed to be returned to their source areas and were not placed in a WMF. As shown in Figures 11-1 and 11-2, an equal volume of remedial waste is dispositioned in five years with on-site disposal versus sixteen years under the off-site disposal option. A description of the hypothetical cost model is presented in Appendix C.

The on-site option not only manages the waste in a more expeditious time frame and reduces risk to the environment and public, but total costs expenditures are reduced significantly. As mentioned earlier, funding from Congress for future environmental cleanup is being reduced and will become more difficult to justify. On-site disposal is 78% less expensive than off-site disposal. On-site disposal would enable an expedient reduction environmental risks at RFETS since the annual budget would not be consumed by off-site disposal costs. This in turn, would result in greater overall risk reduction and long-term protectiveness of human health and the environment. Finally, another advantage to on-site disposal is that the waste would be retrievable if a more cost effective treatment is discovered in the future.

The primary challenge associated with an on-site WMF will be to obtain approval for siting a CAMU on-site. Off-site facilities are currently permitted and are ready to accept waste for disposal despite problems with logistics and higher costs than on-site facilities.

Clearly, on-site waste management is the only cost-effective and viable option for the management of RFETS ER waste. The next step in reducing the current risks at RFETS is to determine the location, design, and operating parameters for the WMF.

32

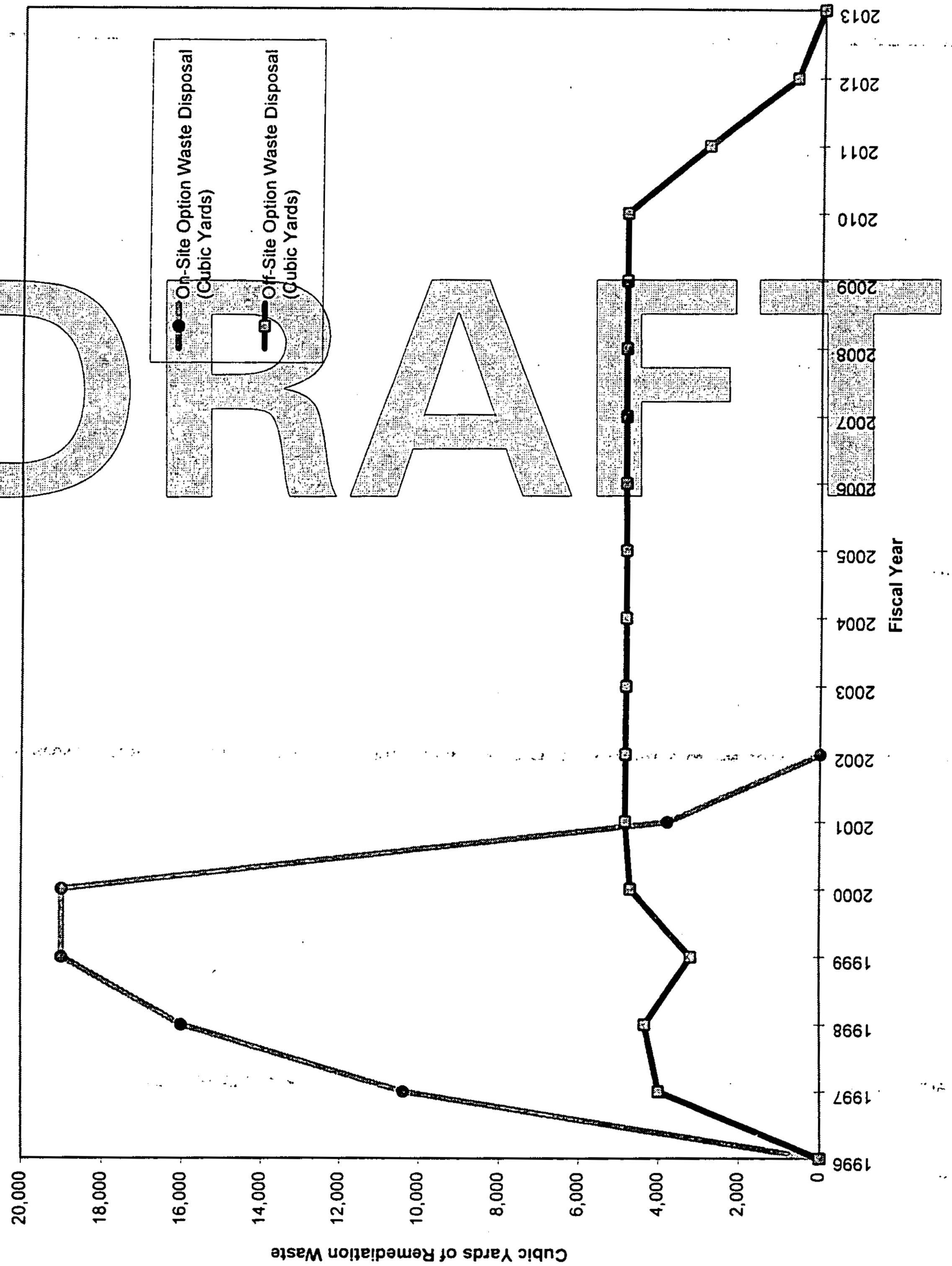




## Table 9-1 Remediation Waste (Cubic yards) Treated By Fiscal Year

| Fiscal Year | On-Site Option Waste Disposal (Cubic Yards) | On-Site Option Thermal Desorption Treated Soil (Cubic Yards) | On-Site Option Total Waste Volume (Cubic Yards) | Off-Site Option Waste Disposal (Cubic Yards) | Off-Site Option Therm Desorption Treated Soil (Cubic Yards) | Off-Site Option Total Waste Volume (Cubic Yards) |
|---|---|---|---|---|---|---|
| 1996 | 0 | 7,200 | 7,200 | 0 | 7,200 | 7,200 |
| 1997 | 10,390 | 9960 | 20,350 | 4000 | 3600 | 7,600 |
| 1998 | 16,011 | 4,770 | 20,781 | 4,339 | 2,377 | 6,716 |
| 1999 | 19,005 | 2,100 | 21,105 | 3,206 | 6,678 | 9,884 |
| 2000 | 19,005 | 2,100 | 21,105 | 4,702 | 953 | 5,655 |
| 2001 | 3,797 | 11,128 | 14,925 | 4,848 | 536 | 5,384 |
| 2002 | 0 | 0 | 0 | 4,848 | 536 | 5,384 |
| 2003 | | | | 4,848 | 536 | 5,384 |
| 2004 | | | | 4,848 | 536 | 5,384 |
| 2005 | | | | 4,848 | 536 | 5,384 |
| 2006 | | | | 4,848 | 536 | 5,384 |
| 2007 | | | | 4,848 | 536 | 5,384 |
| 2008 | | | | 4,848 | 536 | 5,384 |
| 2009 | | | | 4,848 | 536 | 5,384 |
| 2010 | | | | 4,848 | 536 | 5,384 |
| 2011 | | | | 2,819 | 7,853 | 10,672 |
| 2012 | | | | 660 | 3,240 | 3,900 |
| 2013 | | | | 0 | 0 | 0 |
| Total Volume | 68,208 | 37,258 | 105,466 | 68,208 | 37,258 | 105,466 |

**Figure 9-1 Disposed Remediation Waste Versus Fiscal Year**



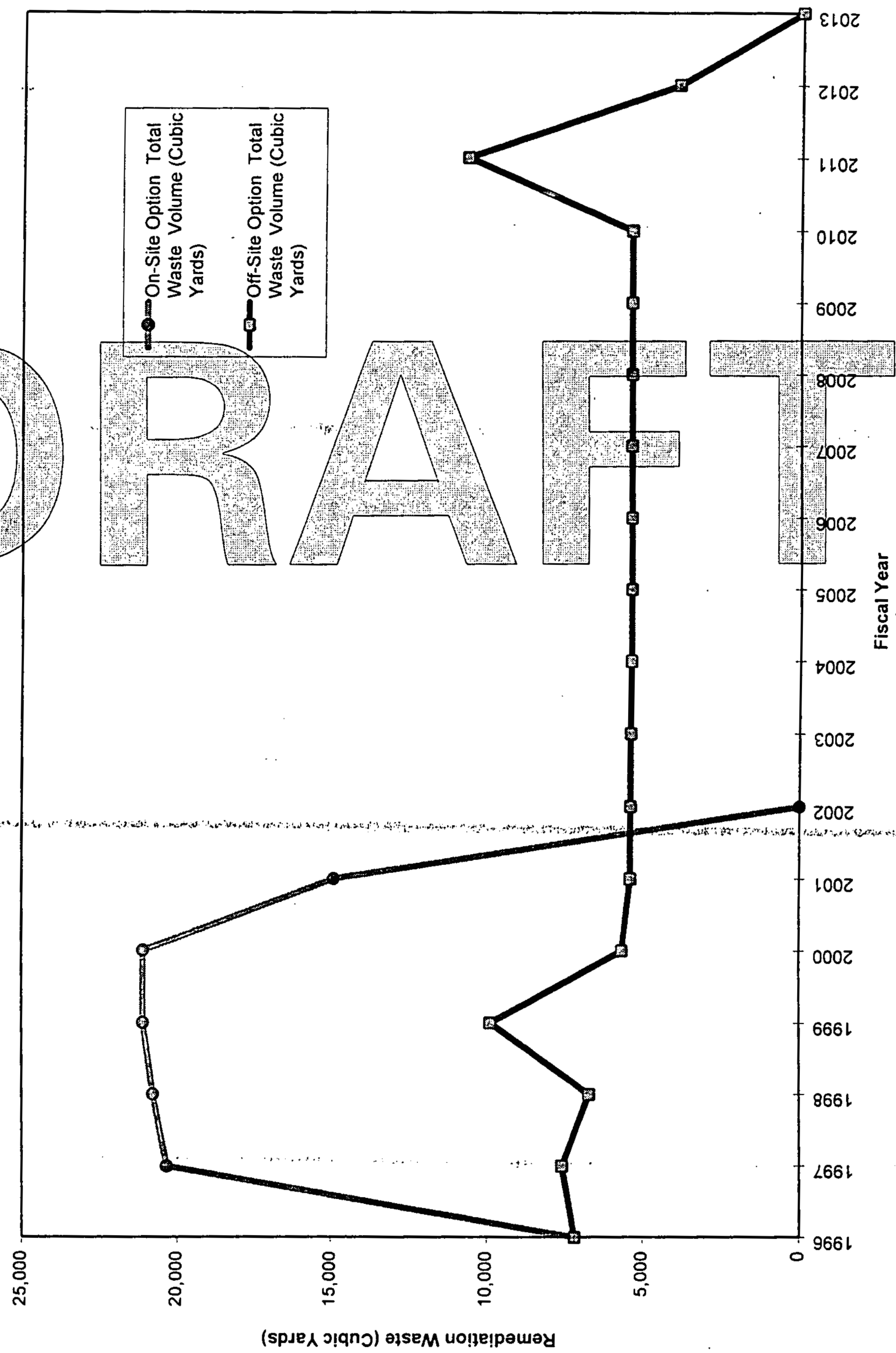



**Figure 9-2 Total Waste Dipostioned From Accelerated Actions Versus Time**
(Includes both treated waste and waste diposal)





34

# Appendix A - Assumptions

## General Assumptions

1) Assume that on-site waste management would be conducted under CAMU guidance and would not have to meet LDRs.

2) Assume that the on-site waste management facility would be designed to not pose a risk to the public for a thousand years per 10-CCR 1007-2, Part 2, Requirements For Siting of Hazardous Waste Disposal Sites.

3) Assume that volatile and semi-volatile organic constituents in the remediation waste would be treated using thermal desorption or vitrification prior to placement in a disposal facility. Assume that soils with just volatile and semivolatile organic compounds would be treated with thermal desorption and returned to their point of excavation.



4) No New Interim Storage Facilities will be planned or budgeted for future storage of waste.

5) A limited budget in FY-96 exists ~~for ER~~ the program. Outyear budgets have not been confirmed, however, the outlook doesn't appear much more promising than FY-96.

6) The use of railway shipment for bulk waste offsite would not require upgrades or modifications to the existing system.

## Waste Volume Estimate Assumptions (as presented in Table 5-1)

1) OU 4 is completely funded for FY-96 and FY-97 activities. Volume estimate ranges from 10,700 cy to 160,000 cy. The value chosen assumes the vadose and surficial soils will require minimal remedial action based on risk to human health and the environment.

2) The waste types exhibited are LLMW, Hazardous Waste, and LLW.

3) Assume that eighty-five percent of the IDM waste (4450 drums) will be dispositioned for disposal at the present sanitary landfill when Procedure FO.29A is approved. The 1200 cy is approximately 4450 drums.

4) "Potential Early Actions" (PEAs) residuals will be disposed in the Waste Management Facility if residuals cannot be returned to the source location.

5) Table 5-1 <u>does not</u> include volumes for the rest of the IHSS's in the Industrial Area, because due to budgetary constraints, there is insufficient sampling results to project potential remediation waste volumes. Remediation activities at OUs 1, 3, 5, 6, 7, 11, and 15 are not anticipated to generate significant waste volumes and so these volumes were also not included in the estimate.

6) The total estimate of 78,450 cy is based on a 15% fluff/expansion factor.

7) The schedule for accelerated actions is presently unknown due to potential budgetary constraints. The volumes of the accelerated action removals do not represent the total cleanup of RFETS.

**Cost Analysis Assumptions**

1) For off-site disposal all LLW will go to NTS and all LLMW and hazardous waste will go to Envirocare.

2) Only the OU 2 903 Pad and Lip Area is considered straight LLW.

3) For off-site disposal only small quantities of waste will be packaged in crates for off-site shipment.

4) The remaining waste (approximately 98%), destined for off-site disposal, will be packaged in bulk in roll-offs. Roll-offs are large rectangular containers constructed of steel which can be placed on tractor trailers or rail cars. The roll-offs were assumed to have a capacity of 20 cubic yards (cy).

5) No waste will be required to be packaged in crates for on-site waste management.

6) All waste destined for off-site management will be packaged in roll-off containers.

7) Envirocare will accepts waste in roll-off containers and will allow the waste to be disposed of in bulk. They will proceed to decontaminate the roll-off containers allowing them to be used again. For this reason, no more than two months supply of roll-off containers will be needed. It appears that Kaiser-Hill's performance measure for waste shipments will be to ship 500 cubic yards (on average) off-site every two months. Therefore 34 roll-off containers will be procured (see Appendix A for the calculation).

8) RFETS will have the capabilities to handle and manage the roll-offs. Currently RFETS does not have the equipment to handle and manage large amounts of shipments via roll-offs.

9) Waste characterization costs will be similar to the actual costs of the OU-1 Hot Spot removal.

10) RFETS overhead costs and subcontractor costs will remain the same in the future.

11) Rail transportation will be available for LLMW shipments to Envirocare.

12) NTS does not currently have a rail spur and doesn't appear one will be built in the near future. So all LLW being shipped to NTS will be done in roll-offs via truck (approximately 5% of the total waste volume estimate). Also, due to the fact that

all waste shipments are currently being shipped via truck it is safe to assume that practice will continue. Therefore it was assumed that 25% of the total waste amounts will be shipped by truck and the remaining 75% of the total waste will be shipped by rail.

13) The NTS tipping fee will remain at $17/cubic foot.

14) RFETS will be allowed to utilize the Envirocare "Above 25,000 Cubic Yard" price schedule (least expensive of three options).

15) Each of the roll-offs will be decontaminated for "Unlimited Release" by Envirocare and will not be disposed of in their cell.

16) 70% of the waste will be shipped in the summer and 30% of the waste will be shipped in the winter.

17) RFETS will not ship any small waste streams (less than 4,000 cubic yards).

18) No material will be shipped with dimensions greater than 10" (D4 debris is excluded from this analysis).

19) No waste will be shipped with greater than 10% debris (D4 Debris is excluded from this analysis).



20) All treatment other than the OU-4 sludge (which will be solidified) will be accomplished through thermal desorption.

21) Waste managed in the on-site cell will be managed under CAMU guidelines.

22) Post Closure Care and Monitoring will be done on quarterly basis for the first ten years and semi-annually for the remaining ten years. This is for groundwater monitoring only. Cap maintenance will be conducted as needed.

**Schedule Assumptions:**

1) The use of laboratories in the State of Colorado which are Utah Certified are few and far between which could cause schedule delays.

2) A minimum of twenty six (26) weeks will be required before waste could be shipped offsite to Envirocare.

3) A minimum of five weeks will be required for the Onsite Waste Management Facility.

4) Assuming 25% of the total waste (e.g. 25,000 cy) was bulk shipment offsite by trucking, using 20 cy roll-off containers would become a lengthy process, (e.g. 8 years), based on shipping 500 cy every two months. This equates to 36 truckloads in a two month period. This also assumes no delays in the waste characterization process.

**Hypothetical Model for Waste Volume Cost over Time Assumptions**

1) The waste disposal and treatment options were based on an annual budget of $25M for ER activities except a budget of $10M for FY 96 . This budget was used in planning for outyear activities as well.

2) The treatment option of thermal desorption was used for onsite and offsite since it was conservative across the board.

3) The total volume does not include all the high risk removal actions since other areas in the Industrial Zone have not been totally characterized because of budget constraints in the past. However, it does represent the majority high risk waste volumes outside of D4 activities.

4) No waste will be disposed of until FY-97.

DRAFT

# Appendix B - Basis of Estimates for On-Site and Off-Site Waste Management Cost

DRAFT

# WASTE CONTAINERS, PACKAGING AND CHARACTERIZATION

## CRATE PACKAGING AND PREPARATION

For the purposes of this estimate it was assumed that the waste would not be packaged in drums because of the higher costs.

Due to their small quantities, the following wastes likely will be packaged in half-crates see Table 5-1):

| | | |
|---|---|---|
| OU-2 Trench T-2 | | 0 cu. yd. |
| OU-4 Debris | | 700 cu. yd. |
| OU-9 Tank 40 | | 130 cu. yd. |
| OU-6 B-1 Dam | | 8 cu. yd. |
| Hot Spot Removals | | 50 cu. yd. |
| IDM | | 180 cu. yd. |
| | TOTAL | 1,068 cu. yd. |

Or, approximately 2% (2,000 c.y.) of the total waste volume will be packaged in half-crates

| CRATES | QTY UNIT | BASIS OF ESTIMATE |
|---|---|---|
| Volume of a half crate | 56 c.f. | (standard volume) |
| Cubic yards of waste per half crate - loss due to packaging | 50 c.f. | Experience from operators |
| Volume of waste to be disposed in half crates (cubic yards) | 2,000 c.y. | From above |
| Volume of waste to be disposed in half crates (cubic feet) | 54,000 c.f. | 2,000 c.y. X 27 c.f./c.y. |
| Number of crates required | 1,080 crates | (54,000 c.f.)/(50 c.y./crate) |
| Cost to procure one half crate | $260 | Actuals |
| RFETS mark-up on half-crates | $240 | Actuals |
| Cost per half-crate | $500 | $260 + $240 |
| Total cost of crates | $540,000 | 1,080 crates X $500/crate |

# WASTE CONTAINERS, PACKAGING AND CHARACTERIZATION

| CRATE PACKAGING | QTY | UNITS | BASIS OF ESTIMATE |
|---|---|---|---|
| Crates packaged per hour | 1 | crates/hr | Experience from operators |
| Number of crates | 1,080 | crates | From above |
| Total hours to install lids on Loaded Crates | 1,080 | hours | (1080 lids)/(1 crates/hr) |
| Cost per labor hour | $85 | /hr | Assumed w/mark-ups |
| Total cost to install lids | $91,800 | | $85/hr X 1,080 hours |

## ROLL-OFF PACKAGING AND PREPARATION

Assume that all waste disposed of on-site or off-site will be packaged in roll-offs. Thus the same number of roll-offs would have to be procured and packaged in either case.

Because Envirocare will decontaminate the roll-offs after waste disposal, it was assumed that only enough roll-offs for two months of waste disposal would be needed.

| ROLL-OFFS | QTY | UNIT | BASIS OF ESTIMATE |
|---|---|---|---|
| Cubic yards per roll-off | 20 | c.y. | Most economical |
| Weight allowed in trucks for transportation | 22.5 | tons | DOT regulations |
| Density of soils at RFETS | 1.62 | tons/c.y. | Merrick Conceptual Design Document for the New Sanitary Landfill |
| Volume of waste allowed in one truck | 13.9 | c.y. | (22.5 tons)/(1.62 tons/c.y.) |
| Number of roll-offs needed to achieve 500 c.y. shipments every 2 months | 36 | roll-offs | calculation |
| Cost per roll-off | $5,500 | /roll-off | Actuals from Trench T-3 and T-4 Removal Project |
| Mark-up on roll-offs | $5,070 | | |
| Cost per roll-off | $10,570 | | |
| Total cost for roll-offs | $380,500 | | (Rounded) |

# WASTE CONTAINERS, PACKAGING AND CHARACTERIZATION

| ROLL-OFF PREPARATION | QTY | UNIT | BASIS OF ESTIMATE |
|---|---|---|---|
| Man-hours to package one roll-off | 4 | hours | Actuals from Trench T-3 and T-4 Removal Project |
| Amount of waste in roll offs (off-site) | 98,000 | c.y. | 100,000 cy - 2,000 cy (in crates) |
| Amount of waste in roll-offs (on-site) | 100,000 | c.y. | Ground Rule from Section 7.0 of this document |
| Volume of waste allowed in one truck | 13.9 | c.y. | From above |
| Number of times the 36 roll-offs need to be packaged (off-site) | 7,056 | times | Calculation |
| Number of times the 36 roll-offs need to be packaged (on-site) | 7,200 | | Calculation |
| Cost per labor hour | $85 | /hour | Approximate average labor rate |
| Total cost for roll-off preparation (off-site) | $2,399,000 | | |
| | | | |
| Total cost for roll-off preparation (on-site) | $2,448,000 | | |



42

# WASTE CONTAINERS, PACKAGING AND CHARACTERIZATION

## WASTE CHARACTERIZATION COSTS:

### OFF-SITE SAMPLING/CHARACTERIZATION

Assume that the characterization costs will be similar to those of the OU-1 Hot Spot Removal

| Crate Sampling/Characterization | | | |
|---|---|---|---|
| Number of crates | | 1,080 crates | From crate calculation (page 2) |
| Cost to characterize one waste crate | $ | 9,150 | Actuals from OU-1 Hot Spot Removal |
| RFETS characterization mark-up | $ | 8,434 | |
| Total cost to characterize one crate | $ | 17,584 | |
| Total cost to characterize the crates | $ | 18,991,000 | |

| Roll-off Sampling/Characterization | | | |
|---|---|---|---|
| Number of Roll-off shipments | | 7,056 Roll-offs | From roll-off calculation (page 3) |
| Cost to characterize one roll-off | $ | 9,150 | Actuals from OU-1 Hot Spot Removal |
| Characterization mark-up | $ | 8,434 | |
| Total cost to characterize one roll-off | $ | 17,584 | |
| Total cost to characterize the roll-offs | $ | 124,073,000 | |

43

# WASTE CONTAINERS, PACKAGING AND CHARACTERIZATION

## ON-SITE SAMPLING/CHARACTERIZATION

Assume that all characterization has/will occur during the individual Accelerated Action PAM process

Assume one person full time to characterize the waste

| Roll-off Sampling/Characterization | | | |
|---|---|---|---|
| Total volume of waste | | 100,000 c.y. | Ground Rule from Section 7.0 |
| Amount of waste that will likely be disposed of in the cell per day | | 250 c.y. | Setforth Design Criteria |
| Number of working days of operation | | 400 days | 100,000 c.y./250 c.y./day |
| Cost of one person per day | $ | 680 /day | Approximate average labor rate |
| Total cost to characterize on-site | $ | 272,000 | |

44

# WASTE CONTAINERS, PACKAGING AND CHARACTERIZATION

**CONTAINER SUMMARY:**

| OFF-SITE DISPOSAL | |
|---|---|
| CRATE COST | $540,000 |
| ROLL-OFF COST | $380,500 |
| 25% CONTINGENCY | $230,000 |
| TOTAL OFF-SITE CONTAINER COST | $1,150,500 |

| ON-SITE DISPOSAL | |
|---|---|
| CRATE COST | $0 |
| ROLL-OFF COST | $380,500 |
| 25% CONTINGENCY | $95,000 |
| TOTAL ON-SITE CONTAINER COST | $475,500 |

**PREPARATION SUMMARY:**

| OFF-SITE DISPOSAL | |
|---|---|
| CRATE COST | $91,800 |
| ROLL-OFF COST | $2,399,000 |
| 25% CONTINGENCY | $623,000 |
| TOTAL OFF-SITE CONTAINER COST | $3,113,800 |

| ON-SITE DISPOSAL | |
|---|---|
| CRATE COST | $0 |
| ROLL-OFF COST | $2,448,000 |
| 25% CONTINGENCY | $612,000 |
| TOTAL ON-SITE CONTAINER COST | $3,060,000 |

**SAMPLING/CHARACTERIZATION SUMMARY:**

| OFF-SITE DISPOSAL | |
|---|---|
| CRATE SAMPLING COST | $ 18,991,000 |
| ROLL-OFF SAMPLING COST | $ 124,073,000 |
| 25% CONTINGENCY | $35,766,000 |
| TOTAL OFF-SITE CONTAINER COST | $178,830,000 |

| ON-SITE DISPOSAL | |
|---|---|
| CRATE SAMPLING COST | $0 |
| ROLL-OFF SAMPLING COST | $ 272,000 |
| 25% CONTINGENCY | $68,000 |
| TOTAL ON-SITE CONTAINER COST | $340,000 |

45

# TRANSPORATION COSTS

## OFF-SITE TRANSPORTATION COSTS

### TRUCK CALCULATIONS

Currently, rail shipping is not available at RFETS so it was assumed that some portion of the waste will be shipped via truck. In order to make the off-site disposal option appear feasible we assumed that 25% of the waste will be shipped by truck, i.e. 25,000 cubic yards.

| | | |
|---|---|---|
| | 1.62 | Tons of soil/Cubic Yard - Based on Merrick's "Conceptual Design Document for the New Sanitary Landfill" |
| | 22.5 | Tons/truck - DOT regulation |
| | 13.9 | Cubic Yards of soil/truck - Calculation |
| $ | 2,500 | per truck - Actual negotiated contract |
| $ | 2,300 | RFETS mark-ups on trucks |
| $ | 4,800 | Total cost per truck for shipment |

So, 25,000 cubic yards of soil will be shipped at 13.9 c.y. per truck which equals:

25,000/13.9 = 1,800 trucks

The total trucking cost will be 1,800 trucks X $4,800/truck = **$ 8,640,000**

### RAIL CALCULATIONS

Assume that rail capability will be made available for LLMW shipments to Envirocare

| | | |
|---|---|---|
| | 1.62 | Tons of soil/Cubic Yard - Based on referenced document |
| | 75 | Tons/rail car - DOT regulation |
| | 46.3 | Cubic Yards of soil/rail car- Calculation |
| $ | 2,160 | per rail car - Actual negotiated cost |
| $ | 1,990 | RFETS mark-up on rail cars |
| $ | 4,150 | Total cost for rail car shipments |

Assume that the remaining 75% of the waste (75,000 cubic yards) will be shipped by rail car (see discussion above).

So, 75,000 cubic yards of soil will be shipped at 46.3 c.y. per rail car, which equals:

75,000/46.3 = 1,620 rail cars

The total rail cost will be 1,620 rail cars X $4,150/rail car = **$ 6,723,000**

The total off-site transportation (truck + rail totals) cost is then: **$ 15,363,000**

Note: This information was supplied by the off-site shipment manager of RMRS

# TRANSPORATION COSTS

## ON-SITE TRANSPORTATION COSTS

Assume the average distance from the remediation site to Building 664 or the Waste Management Facility is 3 miles and the costs are $0.30 per mile

Assume that there will be only one truck driver for each trip

Assume, because of the amount of waste inside the Protected Area, that the average trip time is one hour

| | |
|---|---|
| 7,200 | Truck trips - from Roll-Off Preparation |
| 3 | miles a trip |
| $ 0.30 | per mile - RFETS Standard |
| $ 6,500 | Gasoline Expenses |
| 1 | hour travel time to and from disposal site or loading dock |
| $ 85 | Labor rate per hour for the one truck driver |
| $ 612,000 | Total labor costs |
| $ 618,500 | - Total On-site travel expense |

TRANSPORTATION SUMMARY:

| OFF SITE DISPOSAL | |
|---|---|
| ON-SITE TRAVEL EXPENSES | $ 618,500 |
| OFF-SITE TRAVEL EXPENSES | $ 15,363,000 |
| 25% CONTINGENCY | $ 3,995,000 |
| TOTAL OFF-SITE TRANSPORTATION COSTS | $ 19,976,500 |

| OFF SITE DISPOSAL | |
|---|---|
| ON-SITE TRAVEL EXPENSES | $ 618,500 |
| OFF-SITE TRAVEL EXPENSES | $ - |
| 25% CONTINGENCY | $ 155,000 |
| TOTAL ON-SITE TRANSPORTATION COSTS | $ 773,500 |

# DISPOSAL COSTS

## WASTE SHIPPED TO NEVADA TEST SITE (NTS)

Assume that the OU-2 903 Pad and Lip Area is all LLW and will be shipped to NTS. The estimated amount of waste in the OU-2 903 Pad and Lip Area is approximately 5,000 cubic yards (see Table 4-1), or 5% of the total waste volume.

Assume that the removal of this waste will occur during the 1st Quarter of FY97 thus the NTS charge will be $17/cubic foot ($459/cubic yard). The RFETS mark-up for the disposal carge is $423. Therefore the total Nevada disposal charge is $882 per cubic yard.

Thus the cost to ship the waste to NTS is $882/c.y. X 5,000 c.y. = **$ 4,410,000**

## WASTE SHIPPED TO ENVIROCARE

Assume that we will ship above 25,000 cubic yards of waste and are allowed to utilize the Envirocare "Above 25,000 Cubic Yard" price schedule (least expensive of the three options in the Envirocare price sheet).

Assume that we will ship 20% of the waste to Envirocare by truck and 75% of the waste to Envirocare by rail (the remaining 5% is being shipped to NTS - see above).

Assume that each of our roll-offs will have to be decontaminated for "Unlimited Release" by Envirocare.

Assume that 70% of the LLMW will be shipped in the summer and 30% of the LLMW will be shipped in the winter

Assume that we will not ship any small waste streams (less than 4,000 cubic yards)

Assume that we will not ship any material over 10" in any dimension

Assume that we will not ship any waste with greater than 10% debris

Based on these assumptions it will cost RFETS $591 per cubic yard to dispose of the waste at Envirocare. The RFETS mark-up on this disposal charge is $545. Therefore, the total charge to dispose of waste at Envirocare is $1,136 per cubic yard.

The amount of waste that will be shipped to Envirocare is 95,000 c.y. [100,000 cy - 5,000 cy (amount being shipped to NTS)].

So, the total cost to dispose of RFETS waste at Envirocare is $1,136/c.y. X 95,000 c.y. =

**$ 107,920,000**

## TOTAL OFF-SITE DISPOSAL COSTS

| | |
|---|---|
| Total charge to dispose of waste off-site | $ 112,330,000 |
| 25% Contingency | $ 28,082,500 |
| TOTAL OFF-SITE DISPOSAL CHARGE | $ 140,412,500 |

# DISPOSAL COSTS

## DISPOSAL AT ENVIROCARE

| | | |
|---|---|---|
| Amount of Waste (cubic yards) | | 100000 |
| Amount of waste (cubic feet) | | 2700000 |

| HALF CRATE DISPOSAL | | |
|---|---|---|
| Half crate volume | | 56 |
| Total number of half crates | | 48,214 |
| High end Disposal Cost ($ per cubic foot) | $ | 60.49 |
| Low end disposal cost ($ per cubic foot) | $ | 20.25 |
| High end cost per half crate | $ | 3,388 |
| Low end cost per half crate | $ | 1,134 |
| Total high end disposal cost | $ | 163,326,000 |
| Total low end disposal cost | $ | 54,662,000 |

| ROLL-OFF DISPOSAL | | |
|---|---|---|
| Cubic yards per roll-off | | 40 |
| Total number of roll offs | | 2500 |
| High end Disposal Cost ($ per cubic foot) | $ | 59.18 |
| Low end disposal cost ($ per cubic foot) | $ | 20.25 |
| High end cost per roll-off | $ | 63,915 |
| Low end cost per roll-off | $ | 21,865 |
| Total high end disposal cost | $ | 159,788,000 |
| Total low end disposal cost | $ | 54,662,000 |

## DISPOSAL AT NTS

| | | |
|---|---|---|
| Cost per cubic foot | $ | 17 |
| TOTAL COST TO DISPOSE AT NTS | $ | 45,900,000 |

## Appendix C - Description of Hypothetical Cost Model for Accelerated Actions at Rocky Flats Environmental Technology Site

The purpose of the hypothetical cost model for accelerated actions was to compare the cost and schedule impacts of on-site disposal option versus off-site option given a fixed budget. Unit costs were developed based on the FY 96 budget and the estimates in Appendix B as follows:

| | |
|---|---|
| Unit Cost for Excavation and Handling | $ 110/cy |
| Unit Cost for On-Site Disposal | $ 1,060/cy |
| Unit Cost for Off-Site Disposal | $ 4,940/cy |
| Unit Cost for Thermal Desorption | $1,355/cy |

Based on the above unit costs, the cost of thermal desorption, on-site disposal and off-site disposal were calculated for each accelerated action. Based on the FY 96 budget, 10 million dollars were allocated. It was assumed that the budget for each following year was $25 million. All of the accelerated actions were prioritized based on risk. Starting with FY 96, the cost of both thermal desorption and disposal for the highest priority accelerated action was allocated to FY 96, followed by the next highest priority accelerated action and so on until the $10 million budget was consumed. This was repeated again for FY 97 for a $25 million budget and again for the next year until there were no more accelerated actions to allocate. Both the on-site and off-site options were allocated in this manner. Based on the costs allocated for each accelerated action in each fiscal year, the volume of soils treated with thermal desorption and the volume of soil disposed of were determined. These volumes were then plotted versus fiscal year as shown in Figures 9-1 and 9-2.